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THREE LARGE SCALE MODEL SIMULATIONS OF FOUR MONEY GROWTH SCENARIOS

COMPLETED

135

A STAFF STUDY

PREPARED FOR THE USE OF THE

SUBCOMMITTEE ON MONETARY AND FISCAL POLICY

OF THE

JOINT ECONOMIC COMMITTEE
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I

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LETTER OF TRANSMITTAL

AUGUST 31, 1982.

Hon. HENRY S. REUSS,
Chairman, Joint Economic Committee, Congress of the United States,
Washington, D.C.

DEAR MR. CHAIRMAN: Transmitted herewith for the use of the members of the Subcommittee on Monetary and Fiscal Policy, the full Joint Economic Committee, the Congress, and the public at large is a staff study on "Three Large Scale Model Simulations of Four Money Growth Scenarios." The staff study is designed to compare the macroeconomic effects projected by the Chase, DRI, and Wharton models of (1) fast money growth and no money growth, (2) slow money growth and zero money growth, and (3) gradual and sudden reductions in money growth. The models were simulated twice for each of the four money growth strategies. One set of simulations was run to show what the models themselves project. In these runs, the models were not adjusted no matter what results emerged. A second set of simulations was run to allow the Chase, DRI, and Wharton personnel, who managed these runs, to adjust their models in order to obtain results that were acceptable to them. Subcommittee staff had no contact with the Chase, DRI, and Wharton personnel who managed these simulations. Subcommittee staff submitted the scenarios we wanted simulated to General Accounting Office personnel who, in turn, dealt with Chase, DRI, and Wharton.

The simulations were analyzed by Dr. Robert E. Weintraub, Senior Economist for Republican members of the Committee. He was assisted by Richard Buenneke, a Subcommittee intern, and James Estep of the Senate Computer Center. Juanita Morgan typed the manuscript. Dr. Weintraub's analysis shows that at long last we are on the right monetary growth track. For 15 years, beginning in the middle 1960's, money growth surged in recurring waves bringing in its wake repeated cycles of rising inflation and interest rates, followed by recession. In the late 1970's, 1980, and early 1981, the increases in money growth and hence inflation and interest rates worsened and the time lag between recessions shortened. However, lately, since early 1981, money growth has slowed, albeit irregularly, and as a result inflation has dropped sharply and interest rates have fallen dramatically. The stage is set for a strong and sustained economic recovery. And as the simulations and Dr. Weintraub's analysis show, this time the economy will expand without rekindling inflation and high interest rates—events that make our economy vulnerable to recessions, provided that the Federal

Reserve continues to pursue the disinflationary and noninflationary course it embarked upon in October 1979 and, after being forced off by credit controls in March 1980, was able to return to and adhere to in 1981 and 1982.

Special thanks are due to Comptroller General Bowsher and the General Accounting Office staff who assisted on this project.

Sincerely,

Roger W. Jepsen,
Chairman, Subcommittee on
Monetary and Fiscal Policy.

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THREE LARGE SCALE MODEL SIMULATIONS OF FOUR MONEY GROWTH SCENARIOS

By Robert E. Weintraub

INTRODUCTION

This Report discusses how key U.S. macroeconomic variables would behave in the 1982 to 1991 period under four different long-run money growth strategies. Three widely used large-scale econometric models of the U.S. economy were simulated to cast light on the question. The models that were used are: (1) the standard quarterly Chase Econometrics model; (2) the annual model of Data Resources Incorporated (DRI), and (3) the Wharton annual model. The money growth strategies and the length of the simulation period (10 years) were selected by Subcommittee staff. The strategies that were selected are:

1. M_1 growth decelerates to zero in one year and remains at zero;
2. M_1 growth decelerates to zero over a five-year period and then remains at zero;
3. M_1 growth decelerates to 3 percent a year in one year and remains at 3 percent; and
4. M_1 growth accelerates to 10 percent a year over a five-year period and remains there.

These particular strategies were selected to assure that the simulation results would be relevant to the current monetary policy debate. In this regard, strategy (4) represents the fast money growth alternative to both moderate and no money growth. The match-up of strategies (1) and (3) juxtaposes the moderate and zero money growth strategies. The match-up of strategies (1) and (2) juxtaposes the sudden and gradual monetary cures for inflation.

The models that were used to perform the simulations were selected by Chase, DRI, and Wharton. Subcommittee staff assumed that all three services would use the best model they had for shedding light on how the U.S. macroeconomy would respond over a ten-year period to the different money growth strategies and would manage the simulations to the best of their abilities.

Each model was simulated twice for all four money growth strategies. For each money growth strategy, there was a "pure" simulation and a "managed" simulation. The results of the pure simulations show what the models themselves predict, given how these models were defined early in 1982 when the simulations were performed. In the pure simulations, the models were not adjusted regardless of far-fetched, puzzling, or otherwise strange results, not even if they broke down. The managed simulations were performed by Chase, DRI, and Wharton personnel without interference. The managers were allowed to achieve results that were acceptable to them. Chase, DRI, and Wharton personnel were permitted to adjust their models as they pleased—to change equations and parameters as they saw fit in order to obtain results that they deemed to be more sensible than the results that emerged from the pure simulations.

Subcommittee staff had no contact whatever with personnel of Chase, DRI, and Wharton during the period when the simultations were run and the results were assembled. The money growth strategies that we wanted simulated were given to General Accounting Office (GAO) personnel. These persons in turn dealt with the Chase, DRI, and Wharton personnel. We presumed that neither the GAO personnel involved nor the Chase, DRI, and Wharton personnel who performed the managed simulations had preconceived biases that they wanted to affirm. For example, we assumed they did not care whether the fast money growth strategy generated happier—or less welcome—results than the moderate and no money growth strategies, or whether the results were monetarist or Keynesian.

Brief explanatory comments on project procedures by GAO personnel and complete simulation results are appended to these introductory remarks. GAO's explanatory comments overlap our remarks to some extent. They are unedited. The simulation results are set forth without change in Tables I, II, and III in the appendix to these introductory remarks which is Appendix A. Our analysis of the results follow next. Explanatory remarks by Chase, DRI, and Wharton personnel are presented unedited after our analysis in Appendices 1, 2, and 3.

Our analysis consists of six chapters. In Chapter I, we discuss the nominal GNP and velocity results. In Chapter II, we discuss the real GNP and unemployment results. In Chapter III, we discuss the GNP inflation and interest rate results. In Chapter IV, we discuss the wage inflation and unemployment trade-off results. In Chapter V, we discuss money supply results. In Chapter VI, we summarize the results and set forth conclusions on the proper course of monetary policy.

In summary, and very briefly here, the pure simulations show that, as they now are, the Chase, DRI, and Wharton models cannot be used by themselves—that is, without management—to decide what money growth strategy is optimal in the long run; not even whether 10 percent growth per year will bring happier results than zero growth. The pure simulations produce a variety of puzzling results which suggest that none of the models, as now delineated, defines the links betweeen money growth and other key macroeconomic variables well enough to resolve these questions without management.

The managed results, viewed collectively, show that, to a large extent, fast money growth ultimately is dissipated in inflation and that real GNP growth is substantially unchanged. Increased money growth is not fully dissipated in inflation because, to some extent, the rate of rise of velocity falls as money growth increases. At the end of the simulation period, the absorption is two-thirds in Chase's managed simulations, about two-fifths in DRI's, and one-fifth in the Wharton managed simulations. Put otherwise, about 80 percent of incremental money growth results in increased inflation in the Wharton manged simulations, 60 percent in DRI's and only one-third in the Chase managed simulations.

The interest rate and unemployment results of the DRI and Wharton managed simulations are consistent with their inflation and real GNP results. Interest rates rise with faster money growth and higher inflation, and unemployment is unchanged. This is not so in the case of the interest rates and unemployment results of the Chase managed simulations. Both short-term interest rates and unemployment are higher in the lower money growth scenarios in the Chase managed simulations.

In toto, the Chase managed results provide some support for fast money growth but the case is not believable or consistent. The DRI and Wharton managed results argue strongly and consistently against it. Moreover, their results provide some basis for choosing the no money growth strategy. However, they do not provide any reason for opting for or against gradualism—i.e., for or against gradually decelerating money growth to zero as opposed to reducing it quickly.

It goes without saying that the managed results were greatly influenced by the economic judgments of the simulation managers. In this regard, we stress two points here. First, those who use models to help in deciding appropriate economic policies cannot, now at least, escape making judgments about economic behavior and responses. Models still are only imperfect analytical tools. Second, the judgments that guided the managed simulations were made by Chase, DRI, and Wharton personnel with no input whatever from us.

Finally, we note here at the outset of our report that our analysis ignores fiscal policy changes even though the simulations generate deficit levels. Some will criticize this procedure. They will argue that deficits affect other macroeconomic variables. That is true. However, many economists believe that deficits have only marginal effects on inflation, interest rates, real growth, unemployment, velocity and nominal GNP growth—assuming they are not monetized. And that appears to be the case in the managed simulations of this report.

Inspection of the managed simulation results shows that deficits are higher in money growth scenarios numbers 1 and 2 than they are in scenarios 3 and 4 when money growth is relatively high. Conceivably, it is because of these relatively high deficits that the rate of rise of velocity is relatively high when money growth is low. In turn, that would help to account for the fact that neither nominal GNP growth nor inflation adjust percentage point for percentage point as money growth rises across strategies in the managed simulations. To the extent that explanation is valid, it is quantitatively more important for the Chase managed simulation results where real short-term interest rates are relatively high in the low money growth scenarios than for the DRI and Wharton managed simulations results where interest rates very nearly reflect inflation in the long run. In the DRI and Wharton cases, deficit effects on interest rates and thereby on the rate of rise of velocity, nominal GNP growth and inflation are at most minor. And, in no case are the effects of the deficit strong enough to prevent nominal GNP growth and inflation from rising with money growth across strategies. Moreover, only in Chase's managed simulations does real GNP growth rise with money growth across strategies, and that rise is only marginal. Finally, it should be kept in mind that the relatively high deficits which resulted in the managed simulations of the low money growth strategies may themselves have been caused by the relatively low inflation rates that also resulted in the managed simulations of the low money growth strategies.

Of course, even though deficits may have only marginal effects on other macroeconomic variables, they can affect the product mix of the economy powerfully. Our point is not that deficits are somehow good for the economy, or even without macroeconomic effects, but only that macroeconomic performance depends much more on the growth of the money supply, and fast money growth is not required even with high deficits.

APPENDIX A

GAO COMMENTS ON SIMULATION PROCEDURES

Each of the three major models was run with four different monetary scenarios. Each scenario was run in two ways; all are compared to the model's baseline projections. The three models were those of Wharton, DRI, and Chase Econometrics. The first two of these were annual models built specifically for long-run applications. Chase has only its standard quarterly model run out over a 10-year period.

When the services are asked to run simulations, they typically make many adjustments to their models to ensure an acceptable result. These alterations include changes to other exogenous variables to ensure consistency, required adjustments to variables that are exogenous to the model but that in the economy are actually endogenous, and changes to endogenous variables that the model builders do not believe are responding correctly to the simulation specifications.

We asked each of the firms to run simulations of this type for the monetary growth scenarios, changing whatever they felt needed adjustment. These simulations are referred to as "managed." We also ran the models changing only the monetary growth rates; these are the "pure" simulations and represent what the models themselves do without tinkering.[1]

The growth scenarios are as follows: M_1 was reduced to 3 percent growth per year after only a single year's adjustment (sudden deceleration). It was also raised to 10 percent growth per year after a five-year adjustment (gradual acceleration). Finally, it was reduced to 0 percent growth in both single year (sudden deceleration) and five-year (gradual deceleration) adjustments. In the Wharton model, the target variable was M_2 instead of M_1. The scenarios for Wharton were a sudden deceleration to 7 percent M_2 growth, gradual acceleration to 14 percent M_2 growth, a sudden deceleration to 4 percent M_2 growth, and a gradual deceleration to 4 percent M_2 growth. These were designed to roughly correspond to the M_1 targets.

None of the models permit direct control of M_1. The Wharton model permits a choice of M_2 and interest rate targeting. Both Chase and DRI control money growth through nonborrowed reserves. DRI has an iterative procedure that permits the user to find the nonborrowed reserve levels required to hit an M_1 target. The M_1 growth targets in the Chase model are achievable largely through a trial and error approach.

The output tables display the baseline forecasts of the March version of the forecasts of the models. For each scenario, the data for both pure and managed runs are shown. There are rates of change of money (M_1, M_2), nonborrowed reserves, velocity (for both M_1 and M_2), currency deposit ratio (M_1 definition), GNP (real and nominal), prices (GNP deflator, CPI, personal consumption deflator, depending what was available) and wages (or in DRI, index of hourly earnings). The level of the currency deposit ratio, unemployment, and the Federal deficit[2] is also shown. Four interest rates are given. These include two short rates: three-month Treasury bills and commercial paper;[3] and two long rates: new issues of high grade corporate bonds and mortgage rates. The Chase table also includes the Federal funds rate.

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[1] For the Chase Model, which has a wider range of policy variables, the discount rate was also changed to move in discrete approximations of the Federal funds rate.

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[2] These are in current dollars; the Wharton figure is a close approximation derived by multiplying the real deficit by the GNP deflator.

[3] For Wharton and Chase, this is four to six months; for DRI, it is three months.

TABLE APPENDIX A.1.1.—CHASE ECONOMETRICS QUARTERLY MODEL: GRADUAL DECELERATION TO 0 PERCENT ANNUAL M_1 GROWTH: STRATEGY 2 RESULTS

[Baseline results derived under March 1982 assumptions and Chase's long-term moderate growth scenario. This scenario is not one of our 4 experimental strategies]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
M_1 (percent change):										
Baseline	6.32	6.29	6.02	6.12	6.44	6.71	6.44	6.46	6.11	6.36
Managed	4.68	3.41	2.11	1.05	−.32	−.28	−.36	.13	.51	5.59
Pure	4.80	3.62	2.43	1.26	.01	−.10	−.31	−.22	.32	5.52
M_3 (percent change):										
Baseline	9.98	10.37	10.08	9.21	9.27	9.48	9.56	9.42	9.22	9.11
Managed	9.20	8.90	8.04	6.67	6.26	6.48	6.82	7.00	7.24	8.06
Pure	9.31	9.23	8.60	7.29	6.86	7.01	7.18	7.01	6.95	7.97
Nonborrowed reserves (percent change):										
Baseline	9.17	6.70	6.59	7.15	6.88	6.62	6.38	6.13	6.00	5.90
Managed	4.36	−1.81	−5.28	−9.99	−18.46	−25.90	−35.42	−57.03	−98.38	−90.00
Pure	4.36	−1.81	−5.28	−9.99	−18.46	−25.90	−35.42	−57.05	−98.38	−90.00
M_1 velocity (percent change):										
Baseline	.25	5.14	4.92	4.49	3.98	3.31	3.21	2.99	3.05	2.48
Managed	1.57	6.47	6.93	8.28	9.04	8.89	8.65	8.01	7.29	1.61
Pure	1.72	7.58	8.11	8.81	9.67	9.08	8.71	8.23	7.30	1.81
M_3 velocity (percent change):										
Baseline	−3.41	1.06	.86	1.40	1.15	.54	.09	.03	−.06	−.27
Managed	−2.95	.98	1.00	2.66	2.46	2.13	1.47	1.14	.56	−.86
Pure	−2.79	1.97	1.94	2.78	2.82	1.97	1.22	1.00	.67	−.64
Currency deposit ratio (level):										
Baseline	.389	.400	.403	.408	.434	.462	.490	.519	.546	.559
Managed	.397	.423	.443	.476	.552	.648	.760	.898	1.047	1.071
Pure	.397	.422	.444	.478	.555	.651	.763	.898	1.043	1.069
Currency deposit ratio (percent change):										
Baseline	.5	2.8	.8	1.2	6.4	6.5	6.1	5.9	5.2	2.4
Managed	2.6	6.5	4.7	7.4	16.0	17.4	17.3	18.2	16.6	2.3
Pure	2.6	6.3	5.2	7.7	16.1	17.3	17.2	17.7	16.1	2.5

TABLE APPENDIX A.1.2.—CHASE ECONOMETRICS QUARTERLY MODEL: GRADUAL DECELERATION TO 0 PERCENT ANNAUL M_1 GROWTH: STRATEGY 2 RESULTS

[Baseline results derived under March 1982 assumptions and Chase's long-term moderate growth scenario. This scenario is not one of our 4 experimental strategies]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Nominal GNP (percent change):										
Baseline	6.57	11.43	10.94	10.61	10.42	10.02	9.65	9.45	9.16	8.84
Managed	6.25	9.88	9.04	9.33	8.72	8.61	8.29	8.14	7.80	7.20
Pure	6.52	11.20	10.54	10.07	9.68	8.98	8.40	8.01	7.62	7.33
Real GNP (percent change):										
Baseline	−.73	3.99	3.90	3.33	3.41	3.22	3.05	3.01	2.85	2.75
Managed	−1.04	2.81	2.54	2.96	2.76	3.11	3.06	3.21	2.95	2.71
Pure	−.77	3.89	3.74	3.26	3.28	3.02	2.80	2.72	2.52	2.80
GNP deflator (percent change):										
Baseline	7.33	7.15	6.78	7.05	6.77	6.58	6.41	6.24	6.14	5.93
Managed	7.34	6.88	6.34	6.19	5.80	5.33	5.07	4.77	4.71	4.39
Pure	7.32	7.04	6.56	6.60	6.20	5.78	5.44	5.14	4.98	4.42
CPI (percent change):										
Baseline	6.96	6.79	6.93	6.75	6.40	6.37	6.33	5.88	5.94	5.79
Managed	7.14	6.93	6.99	6.01	5.91	5.60	5.39	4.84	5.00	4.63
Pure	7.01	6.72	6.74	6.39	5.95	5.73	5.54	4.95	5.02	4.59
Wage rate (percent change):										
Baseline	7.02	7.30	6.87	7.67	7.62	7.78	7.90	7.87	7.56	7.35
Managed	6.76	6.46	5.61	6.11	5.40	5.38	5.38	5.32	5.18	5.26
Pure	6.82	6.74	5.97	6.38	5.82	5.53	5.40	5.20	4.92	5.00

TABLE APPENDIX A.1.3.—CHASE ECONOMETRICS QUARTERLY MODEL: GRADUAL DECELERATION TO 0 PERCENT ANNUAL M_1 GROWTH: STRATEGY 2 RESULTS

[Baseline results derived under March 1982 assumptions and Chase's long-term moderate growth scenario. This scenario is not one of our 4 experimental strategies]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Unemployment rate:										
Baseline	8.94	8.05	7.33	6.62	6.26	5.62	5.49	5.31	5.15	4.98
Managed	9.26	9.04	9.21	9.06	9.31	8.96	9.01	8.98	9.60	9.83
Pure	9.04	8.29	7.78	7.30	7.31	7.13	7.59	8.18	9.54	10.45
3-mo T-bill yield:										
Baseline	12.68	12.22	10.99	9.77	8.90	8.09	7.82	7.60	7.48	7.25
Managed	13.97	14.28	13.81	13.12	13.73	13.47	13.95	13.95	19.94	18.90
Pure	13.04	12.76	11.72	10.84	10.56	10.22	10.44	9.97	15.60	15.44
Commercial paper rate:										
Baseline	13.51	12.97	12.16	10.74	9.78	8.89	8.60	8.36	8.25	8.01
Managed	14.96	15.17	15.01	13.97	14.37	13.78	13.94	13.35	19.84	18.22
Pure	13.92	13.58	12.96	11.83	11.41	10.84	10.80	9.88	15.95	15.24
Corporate bond rate:										
Baseline	15.98	14.45	12.98	12.29	11.35	10.47	10.19	9.97	9.87	9.64
Managed	16.49	15.32	14.06	13.32	12.63	11.58	11.13	10.58	12.57	11.58
Pure	16.12	14.63	13.13	12.41	11.45	10.39	9.81	8.86	10.38	9.42
Mortgage interest rate:										
Baseline	15.62	14.72	13.72	12.58	11.63	10.74	10.44	10.21	10.11	9.88
Managed	16.02	15.50	14.87	13.94	13.33	12.45	12.13	11.80	12.99	12.83
Pure	15.76	14.96	14.06	13.04	12.30	11.57	11.45	11.41	12.67	12.95
Federal funds rate:										
Baseline	13.81	13.16	11.78	10.48	9.50	8.60	8.32	8.09	7.99	7.75
Managed	15.71	15.94	15.23	14.32	14.88	14.15	14.14	12.94	21.38	18.82
Pure	14.35	13.96	12.79	11.81	11.43	10.78	10.59	9.10	17.02	15.62
Government surplus or deficit (level):										
Baseline	−130.85	−123.14	−103.27	−102.81	−97.82	−93.37	−86.60	−80.60	−49.15	−43.79
Managed	−136.89	−148.51	−153.90	−173.28	−199.74	−221.53	−243.19	−275.81	−294.22	−323.05
Pure	−132.12	−127.03	−112.05	−120.61	−129.62	−146.29	−165.60	−191.40	−216.75	−263.01

TABLE APPENDIX A.1.4.—CHASE ECONOMETRICS QUARTERLY MODEL: GRADUAL ACCELERATION TO 10 PERCENT ANNUAL M_1 GROWTH: STRATEGY 4 RESULTS

[Baseline results derived under March 1982 assumptions and Chase's long-term moderate growth scenario. This scenario is not one of our 4 experimental strategies]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
M_1 (percent change):										
Baseline	6.32	6.29	6.02	6.12	6.44	6.71	6.44	6.46	6.11	6.36
Managed	6.96	7.74	8.43	9.47	10.20	10.50	10.53	10.39	10.69	10.66
Pure	6.80	7.58	8.38	9.17	9.99	10.04	10.09	9.91	10.12	9.92
M_2 (percent change):										
Baseline	9.98	10.37	10.08	9.21	9.27	9.48	9.56	9.42	9.22	9.11
Managed	10.32	11.24	11.36	10.81	11.10	11.31	11.57	11.36	11.37	11.26
Pure	10.19	10.91	11.06	10.46	10.73	10.88	11.08	10.86	10.86	10.59
Nonborrowed reserves (percent change):										
Baseline	9.17	6.70	6.59	7.15	6.88	6.62	6.38	6.13	6.00	5.90
Managed	10.69	10.65	13.55	15.61	16.09	14.68	14.73	13.63	14.35	12.95
Pure	10.69	10.65	13.55	15.61	16.09	14.68	14.73	13.63	14.35	12.95
M_1 velocity (percent change):										
Baseline	.25	5.14	4.92	4.49	3.98	3.31	3.21	2.99	3.05	2.48
Managed	−.01	4.83	3.10	3.06	1.53	1.91	.98	.83	.53	.58
Pure	−.22	3.93	2.75	1.76	.88	.56	.23	.30	−.11	−.15
M_2 velocity (percent change):										
Baseline	−3.41	1.06	.86	1.40	1.15	.54	.09	.03	−.06	−.27
Managed	−3.37	1.33	.17	1.72	.63	1.10	−.06	−.14	−.15	−.02
Pure	−3.39	.60	.07	.47	.14	−.28	−.76	−.65	−.85	−.82
Currency deposit ratio (level):										
Baseline	.389	.400	.403	.408	.434	.462	.490	.519	.546	.559
Managed	.386	.392	.384	.378	.389	.402	.413	.425	.432	.434
Pure	.387	.391	.384	.375	.383	.393	.400	.409	.413	.409
Currency deposit ratio (percent change):										
Baseline	.5	2.8	.8	1.2	6.4	6.5	6.1	5.9	5.2	2.4
Managed	−.3	1.6	−2.0	−1.6	2.9	3.3	2.7	2.9	1.6	.5
Pure	0	1.0	−1.8	−2.3	2.1	2.6	1.8	2.2	1.0	−1.0

TABLE APPENDIX A.1.5.—CHASE ECONOMETRICS QUARTERLY MODEL: GRADUAL ACCELERATION TO 10 PERCENT ANNUAL M_1 GROWTH: STRATEGY 4 RESULTS

[Baseline results derived under March 1982 assumptions and Chase's long-term moderate growth scenario. This scenario is not one of our 4 experimental strategies]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Nominal GNP (percent change):										
Baseline	6.57	11.43	10.94	10.61	10.42	10.02	9.65	9.45	9.16	8.84
Managed	6.95	12.57	11.53	12.53	11.73	12.41	11.51	11.22	11.22	11.24
Pure	6.58	11.51	11.13	10.93	10.87	10.60	10.32	10.21	10.01	9.77
Real GNP (percent change):										
Baseline	−.73	3.99	3.90	3.33	3.41	3.22	3.05	3.01	2.85	2.75
Managed	−.38	4.80	4.17	4.30	3.73	4.18	3.46	3.21	3.13	3.16
Pure	−.72	4.03	3.97	[illegible].40	3.54	3.41	3.27	3.26	3.12	3.02
GNP deflator (percent change):										
Baseline	7.33	7.15	6.78	7.05	6.77	6.58	6.41	6.24	6.14	5.93
Managed	7.32	7.42	7.06	7.89	7.70	7.90	7.79	7.76	7.85	7.85
Pure	7.33	7.19	6.89	7.29	7.08	6.96	6.83	6.73	6.69	6.57
CPI (percent change):										
Baseline	6.96	6.79	6.93	6.75	6.40	6.37	6.33	5.88	5.94	5.79
Managed	6.81	6.68	7.05	7.19	6.90	7.00	7.18	7.00	7.29	7.43
Pure	6.94	6.82	7.03	6.94	6.67	7.70	6.71	6.34	6.47	6.42
Wage rate (percent change):										
Baseline	7.02	7.30	6.87	7.67	7.62	7.78	7.90	7.87	7.56	7.35
Managed	7.18	7.80	7.53	9.03	9.18	9.69	9.99	10.17	10.19	10.37
Pure	7.08	7.54	7.38	8.45	8.60	8.87	9.06	9.12	8.96	8.89

TABLE APPENDIX A.1.6.—CHASE ECONOMETRICS QUARTERLY MODEL: GRADUAL ACCELERATION TO 10 PERCENT ANNUAL M_1 GROWTH: STRATEGY 4 RESULTS

[Baseline results derived under March 1982 assumptions and Chase's long-term moderate growth scenario. This scenario is not one of our 4 experimental strategies]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Unemployment rate:										
Baseline	8.94	8.05	7.33	6.62	6.26	5.62	5.49	5.31	5.15	4.98
Managed	8.65	7.25	6.31	5.17	4.63	3.62	3.23	2.95	2.65	2.33
Pure	8.90	7.98	7.20	6.43	6.00	5.27	5.00	4.67	4.31	3.95
3-mo T-bill yield:										
Baseline	12.68	12.22	10.99	9.77	8.90	8.09	7.82	7.60	7.48	7.25
Managed	11.48	10.92	9.56	8.02	8.94	8.66	9.01	9.45	9.63	9.70
Pure	12.51	11.96	10.52	9.16	8.17	7.31	6.86	6.51	6.02	5.48
Commercial paper rate:										
Baseline	13.51	12.97	12.16	10.74	9.78	8.89	8.60	8.36	8.25	8.01
Managed	12.17	11.61	10.75	9.31	9.17	8.68	8.81	9.03	9.09	9.15
Pure	13.35	12.66	11.64	10.12	9.11	8.31	7.97	7.80	7.55	7.30
Corporate bond rate:										
Baseline	15.98	14.45	12.98	12.29	11.35	10.47	10.19	9.97	9.87	9.64
Managed	15.50	13.90	12.50	11.85	11.41	10.83	11.02	11.46	12.06	12.73
Pure	15.93	14.36	12.86	12.20	11.38	10.69	10.59	10.65	10.81	11.01
Mortgage interest rate:										
Baseline	15.62	14.72	13.72	12.58	11.63	10.74	10.44	10.21	10.11	9.88
Managed	15.30	14.24	13.21	12.12	11.45	10.87	10.91	11.10	11.46	11.79
Pure	15.57	14.64	13.60	12.48	11.60	10.84	10.68	10.63	10.70	10.71
Federal funds rate:										
Baseline	13.81	13.16	11.78	10.48	9.50	8.60	8.32	8.09	7.99	7.75
Managed	12.07	11.49	10.09	8.99	8.14	7.59	7.63	7.76	7.78	7.90
Pure	13.64	12.77	11.11	9.72	8.75	8.07	7.85	7.85	7.79	7.80
Government surplus or deficit (level):										
Baseline	−130.85	−123.14	−103.27	−102.81	−97.82	−93.37	−86.60	−80.60	−49.15	−43.79
Managed	−124.19	−102.39	−74.93	−49.64	−29.12	8.77	42.44	73.12	137.78	178.22
Pure	−130.34	−121.73	−99.55	−94.66	−83.18	−70.12	−52.21	−32.27	19.00	45.52

TABLE APPENDIX A.1.7.—CHASE ECONOMETRICS QUARTERLY MODEL: SUDDEN DECELERATION TO 0 PERCENT ANNUAL M_1 GROWTH: STRATEGY 1 RESULTS

[Baseline results derived under March 1982 assumptions and Chase's long-term moderate growth scenario. This scenario is not one of our 4 experimental strategies]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
M_1 (percent change):										
Baseline	6.32	6.29	6.02	6.12	6.44	6.71	6.44	6.46	6.11	6.36
Managed	0	.01	.09	−.01	.02	−.10	.21	3.82	5.47	5.43
Pure	.01	.07	.05	.08	−.04	−.08	.33	6.38	5.12	5.92
M_2 (percent change):										
Baseline	9.98	10.37	10.08	9.21	9.27	9.48	9.56	9.42	9.22	9.11
Managed	7.02	7.03	6.85	6.04	6.40	6.72	7.27	7.70	8.31	8.20
Pure	7.22	7.71	7.62	6.82	6.90	7.08	7.31	8.91	8.72	8.64
Nonborrowed reserves (percent change):										
Baseline	9.17	6.70	6.59	7.15	6.83	6.62	6.38	6.13	6.00	5.90
Managed	−9.66	−14.35	−15.45	−19.67	−27.67	−46.85	−74.17	−96.82	−57.14	−66.67
Pure	−10.84	−15.35	−17.41	−21.41	−32.10	−54.96	−98.42	−30.00	−57.14	−66.67
M_1 velocity (percent change):										
Baseline	.25	5.14	4.92	4.49	3.98	3.31	3.21	2.99	3.05	2.48
Managed	5.70	8.12	8.18	9.23	8.92	8.96	8.03	4.03	2.16	2.37
Pure	6.34	10.57	9.98	9.64	9.53	8.99	8.07	1.71	3.39	2.22
M_2 velocity (percent change):										
Baseline	−3.41	1.06	.86	1.40	1.15	.54	.09	.03	−.06	−.27
Managed	−1.32	1.10	1.42	3.18	2.54	2.14	.97	.15	−.68	−.40
Pure	−.87	2.93	2.41	2.90	2.59	1.83	1.09	−.82	−.21	−.50
Currency deposit ratio (level):										
Baseline	.389	.400	.403	.408	.434	.462	.490	.519	.546	.559
Managed	.424	.469	.502	.546	.632	.749	.878	.974	1.036	1.056
Pure	.423	.471	.510	.558	.652	.773	.910	.963	1.036	1.064
Currency deposit ratio (percent change):										
Baseline	.5	2.8	.8	1.2	6.4	6.5	6.1	5.9	5.2	2.4
Managed	9.6	10.6	7.0	8.8	15.8	18.5	17.2	10.9	5.8	2.4
Pure	9.3	11.3	8.2	9.4	16.8	18.6	17.7	5.8	7.6	2.7

TABLE APPENDIX A.1.8.—CHASE ECONOMETRICS QUARTERLY MODEL: SUDDEN DECELERATION TO 0 PERCENT ANNUAL M_1 GROWTH: STRATEGY 1 RESULTS

[Baseline results derived under March 1982 assumptions and Chase's long-term moderate growth scenario. This scenario is not one of our 4 experimental strategies]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Nominal GNP (percent change):										
Baseline	6.57	11.43	10.94	10.61	10.42	10.02	9.65	9.45	9.16	8.84
Managed	5.70	8.13	8.27	9.22	8.94	8.86	8.24	7.85	7.63	7.80
Pure	6.35	10.64	10.03	9.72	9.49	8.91	8.40	8.09	8.51	8.14
Real GNP (percent change):										
Baseline	−.73	3.99	3.90	3.33	3.41	3.22	3.05	3.01	2.85	2.75
Managed	−1.56	1.64	2.30	3.47	3.20	3.54	3.10	3.02	2.94	2.80
Pure	−.90	3.67	3.59	3.37	3.36	3.15	2.92	3.19	2.97	2.99
GNP deflator (percent change):										
Baseline	7.33	7.15	6.78	7.05	6.77	6.58	6.41	6.24	6.14	5.93
Managed	7.36	6.39	5.84	5.57	5.56	5.13	4.98	4.68	4.56	4.88
Pure	7.29	6.73	6.22	6.15	5.93	5.58	5.33	4.75	5.39	5.02
CPI (percent change):										
Baseline	6.96	6.79	6.93	6.75	6.40	6.37	6.33	5.88	5.94	5.79
Managed	7.57	6.83	6.69	5.43	5.68	5.46	5.36	4.87	4.71	4.96
Pure	7.15	6.42	6.37	6.08	5.71	5.57	5.55	4.53	5.27	5.01
Wage rate (percent change):										
Baseline	7.02	7.30	6.87	7.67	7.62	7.78	7.90	7.87	7.56	7.35
Managed	6.10	5.10	4.66	5.58	5.27	5.50	5.54	5.65	6.24	6.14
Pure	6.20	5.56	5.00	5.73	5.51	5.37	5.40	6.03	6.45	6.08

TABLE APPENDIX A.1.9.—CHASE ECONOMETRICS QUARTERLY MODEL: SUDDEN DECELERATION TO 0 PERCENT ANNUAL M_1 GROWTH: STRATEGY 1 RESULTS

[Baseline results derived under March 1982 assumptions and Chase's long-term moderate growth scenario. This scenario is not one of our 4 experimental strategies]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Unemployment rate:										
Baseline	8.94	8.05	7.33	6.62	6.26	5.62	5.49	5.31	5.15	4.98
Managed	10.04	10.46	10.80	10.51	10.52	10.14	10.62	11.40	10.68	10.52
Pure	9.39	8.82	8.47	8.07	8.17	8.18	9.43	8.97	9.39	9.77
3-mo T-bill yield:										
Baseline	12.68	12.22	10.99	9.77	8.90	8.09	7.82	7.60	7.48	7.25
Managed	17.29	16.45	15.26	13.78	13.93	13.77	17.47	19.46	16.98	18.47
Pure	14.18	13.41	12.27	11.34	11.06	10.33	15.56	10.80	13.92	14.73
Commercial paper rate:										
Baseline	13.51	12.97	12.16	10.74	9.78	8.89	8.60	8.36	8.25	8.01
Managed	18.72	17.55	16.38	14.44	14.29	13.80	17.76	16.69	16.13	17.32
Pure	15.24	14.33	13.51	12.23	11.74	10.61	16.36	10.27	13.40	13.88
Corporate bond rate:										
Baseline	15.98	14.45	12.98	12.29	11.35	10.47	10.19	9.97	9.87	9.64
Managed	17.81	16.24	14.43	13.16	12.18	11.19	12.14	12.44	10.79	10.73
Pure	16.56	14.79	13.07	12.18	11.14	9.87	11.32	8.70	9.35	9.11
Mortgage interest rate:										
Baseline	15.62	14.72	13.72	12.58	11.63	10.74	10.44	10.21	10.11	9.88
Managed	17.07	16.63	15.76	14.44	13.54	12.75	13.34	14.07	12.92	12.49
Pure	16.21	15.40	14.44	13.33	12.61	12.05	13.29	11.87	12.44	12.64
Federal funds rate:										
Baseline	13.81	13.16	11.78	10.48	9.50	8.60	8.32	8.09	7.99	7.75
Managed	20.62	18.93	16.84	14.77	14.60	13.93	19.10	21.31	16.21	17.40
Pure	16.06	14.94	13.46	12.22	11.68	10.15	17.79	9.34	13.10	13.44
Government surplus or deficit (level):										
Baseline	−130.85	−123.14	−103.27	−102.81	−97.82	−93.37	−86.60	−80.60	−49.15	−43.79
Managed	−151.10	−180.65	−194.08	−209.13	−232.97	−255.37	−284.35	−322.30	−319.09	−349.21
Pure	−136.18	−135.60	−126.66	−141.37	−156.43	−180.61	−219.11	−235.92	−247.63	−279.64

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TABLE APPENDIX A.1.10.—CHASE ECONOMETRICS QUARTERLY MODEL: SUDDEN DECELERATION TO 3 PERCENT ANNUAL M_1 GROWTH: STRATEGY 3 RESULTS

[Baseline results derived under March 1982 assumptions and Chase's long-term moderate growth scenario. This scenario is not one of our 4 experimental strategies]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
M_1 (percent change):										
Baseline	6.32	6.29	6.02	6.12	6.44	6.71	6.44	6.46	6.11	6.36
Managed	2.80	2.86	2.79	2.97	2.73	2.94	2.99	2.83	2.73	2.66
Pure	3.01	3.04	3.04	3.03	2.97	2.88	3.03	3.01	3.02	3.06
M_2 (percent change):										
Baseline	9.98	10.37	10.08	9.21	9.27	9.48	9.56	9.42	9.22	9.11
Managed	8.34	8.55	8.30	7.52	7.64	7.94	8.33	8.15	7.98	7.72
Pure	8.53	8.97	8.83	7.96	7.96	8.09	8.36	8.22	8.16	7.99
Nonborrowed reserves (percent change):										
Baseline	9.17	6.70	6.59	7.15	6.88	6.62	6.38	6.13	6.00	5.90
Managed	−1.33	−4.06	−3.58	−3.79	−6.30	−9.39	−9.14	−11.35	−10.90	−14.88
Pure	−1.33	−4.06	−3.58	−3.79	−6.30	−9.39	−9.14	−11.35	−10.90	−14.88
M_1 velocity (percent change):										
Bseline	.25	5.14	4.92	4.49	3.98	3.31	3.21	2.99	3.05	2.48
Managed	3.20	6.64	6.77	7.20	6.53	6.79	5.88	5.37	4.94	4.49
Pure	3.45	7.98	7.43	7.12	6.92	6.46	5.84	5.59	5.22	4.83
M_2 velocity (percent change):										
Baseline	−3.41	1.06	.86	1.40	1.15	.54	.09	.03	−.06	−.27
Managed	−2.34	.95	1.26	2.65	1.62	1.79	.54	.05	−.31	−.57
Pure	−2.07	2.05	1.64	2.19	1.93	1.25	.51	.38	.08	−.10
Currency deposit ratio (level):										
Baseline	.389	.400	.403	.408	.434	.462	.490	.519	.546	.559
Managed	.407	.435	.451	.473	.525	.589	.655	.727	.800	.853
Pure	.406	.435	.453	.476	.529	.594	.659	.733	.808	.863
Currency deposit ratio (percent change):										
Baseline	.5	2.8	.8	1.2	6.4	6.5	6.1	5.9	5.2	2.4
Managed	5.2	6.9	3.7	4.9	11.0	12.2	11.2	11.0	10.0	6.6
Pure	4.9	7.1	4.1	5.1	11.1	12.3	10.9	11.2	10.2	6.8

TABLE APPENDIX A.1.11.—CHASE ECONOMETRICS QUARTERLY MODEL: SUDDEN DECELERATION TO 3 PERCENT ANNUAL M_1 GROWTH: STRATEGY 3 RESULTS

[Baseline results derived under March 1982 assumptions and Chase's long-term moderate growth scenario. This scenario is not one of our 4 experimental strategies]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Nominal GNP (percent change):										
Baseline	6.57	11.43	10.94	10.61	10.42	10.02	9.65	9.45	9.16	8.84
Managed	6.00	9.50	9.56	10.17	9.26	9.73	8.87	8.20	7.67	7.15
Pure	6.46	11.02	10.47	10.15	9.89	9.34	8.87	8.60	8.24	7.89
Real GNP (percent change):										
Baseline	−.73	3.99	3.90	3.33	3.41	3.22	3.05	3.01	2.85	2.75
Managed	−1.26	2.57	2.90	3.61	3.05	3.77	3.23	2.84	2.52	2.28
Pure	−.82	3.83	3.75	3.34	3.34	3.10	2.91	2.86	2.70	2.63
GNP deflator (percent change):										
Baseline	7.33	7.15	6.78	7.05	6.77	6.58	6.41	6.24	6.14	5.93
Managed	7.33	7.76	6.47	6.34	6.02	5.74	5.46	5.20	5.03	4.77
Pure	7.31	7.93	6.48	6.60	6.34	6.05	5.79	5.58	5.40	5.14
CPI (percent change):										
Baseline	6.96	6.79	6.93	6.75	6.40	6.37	6.33	5.88	5.94	5.79
Managed	7.28	6.79	6.79	6.03	6.02	5.78	5.61	5.10	5.06	4.84
Pure	7.06	6.59	6.61	6.43	6.03	5.92	5.79	5.28	5.26	5.04
Wage rate (percent change):										
Baseline	7.02	7.30	6.87	7.67	7.62	7.78	7.90	7.87	7.56	7.35
Managed	6.48	6.05	5.56	6.62	6.23	6.49	6.40	6.18	5.74	5.35
Pure	6.59	6.40	5.91	6.69	6.49	6.44	6.45	6.36	5.97	5.65

TABLE APPENDIX A.1.12.—CHASE ECONOMETRICS QUARTERLY MODEL: SUDDEN DECERATION TO 3 PERCENT ANNUAL M_1 GROWTH: STRATEGY 3 RESULTS

[Baseline results derived under March 1982 assumptions and Chase's long-term moderate growth scenario. This scenario is not one of our 4 experimental strategies]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Unemployment rate:										
Baseline	8.94	8.05	7.33	6.62	6.26	5.62	5.49	5.31	5.15	4.98
Managed	9.54	9.41	9.38	8.78	8.69	8.08	8.01	8.15	8.39	8.78
Pure	9.17	8.43	7.86	7.26	7.09	6.70	6.81	6.94	7.08	7.29
3-mo T-bill yield:										
Baseline	12.68	12.22	10.99	9.77	8.90	8.09	7.82	7.60	7.48	7.25
Managed	15.06	14.35	13.00	11.46	11.21	10.52	10.38	10.51	10.64	11.43
Pure	13.47	12.80	11.53	10.44	9.81	9.30	9.15	9.27	9.42	10.26
Commercial paper rate:										
Baseline	13.51	12.97	12.16	10.74	9.78	8.89	8.60	8.36	8.25	8.01
Managed	16.18	15.23	14.08	12.23	11.73	10.91	10.60	10.51	10.30	10.84
Pure	14.42	13.63	12.70	11.34	10.53	9.82	9.44	9.32	9.15	9.75
Corporate bond rate:										
Baseline	15.98	14.45	12.98	12.29	11.35	10.47	10.19	9.97	9.87	9.64
Managed	16.93	15.34	13.55	12.39	11.46	10.39	9.88	9.49	9.06	8.70
Pure	16.28	14.61	12.97	12.17	11.15	10.16	9.61	9.16	8.69	8.36
Mortgage interest rate:										
Baseline	15.62	14.72	13.72	12.58	11.63	10.74	10.44	10.21	10.11	9.88
Managed	16.37	15.67	14.66	13.29	12.35	11.45	11.13	10.91	10.76	10.56
Pure	15.93	15.05	14.01	12.84	11.93	11.09	10.76	10.52	10.35	10.16
Federal funds rate:										
Baseline	13.81	13.16	11.78	10.48	9.50	8.60	8.32	8.09	7.99	7.75
Managed	17.29	15.97	14.05	12.20	11.64	10.77	10.33	10.08	9.57	10.09
Pure	15.00	14.03	12.44	11.14	10.27	9.49	8.92	8.64	8.18	8.79
Government surplus or deficit (level):										
Baseline	−130.85	−123.14	−103.27	−102.81	−97.82	−93.37	−86.60	−80.60	−49.15	−43.79
Managed	−142.51	−156.57	−153.42	−156.14	−169.74	−171.30	−175.92	−190.31	−186.29	−212.78
Pure	−133.64	−129.48	−114.94	−121.65	−126.33	−135.94	−145.18	−159.17	−153.52	−177.13

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TABLE APPENDIX A.2.1.—DRI LONG TERM ANNUAL MODEL: GRADUAL DECELERATION TO 0 PERCENT ANNUAL M_1 GROWTH: STRATEGY 2 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1966	1987	1988	1989	1990	1991
M_1 (percent change):										
Baseline	5.6	5.1	4.6	5.5	4.0	4.0	4.6	4.2	4.0	3.8
Managed	4.0	3.0	2.0	1.0	0	0	0	0	0	0
Pure	5.6	4.4	3.4	2.2	1.1	0	0	−.1	−.1	0
M_2 (percent change):										
Baseline	8.3	8.9	9.2	10.8	9.5	9.8	9.1	8.2	8.0	7.7
Managed	7.3	8.0	7.3	6.4	6.0	5.6	5.6	5.6	5.6	5.6
Pure	8.3	7.7	6.9	5.7	5.2	6.7	4.5	6.4	8.8	9.8
Nonborrowed reserves (percent change):										
Baseline	4.6	5.5	5.9	5.2	5.1	6.6	6.7	6.7	6.9	6.5
Managed	−.8	3.6	4.8	4.3	6.4	3.2	3.2	3.1	3.1	3.1
Pure	4.6	−5.2	−3.8	−43.8	−5.9	−84.0	−566.3	−19.5	−2.9	14.8
M_1 velocity (percent change):										
Baseline	.3	5.9	6.5	5.8	6.8	5.9	5.4	5.3	4.9	5.0
Managed	1.0	7.3	7.3	8.7	9.6	8.1	7.8	7.5	6.8	6.4
Pure	.3	5.9	7.0	7.0	9.4	9.3	11.3	11.7	11.2	11.0
M_2 velocity (percent change):										
Baseline	−2.1	2.2	2.0	.7	1.4	.3	1.1	1.4	1.1	1.2
Managed	−2.1	2.3	2.0	3.1	3.4	2.4	2.1	1.8	1.1	.8
Pure	−2.1	2.7	3.5	3.4	5.2	2.4	6.5	4.9	2.1	1.1
Currency deposit ratio (level):										
Baseline	.394	.407	.430	.454	.492	.531	.566	.601	.630	.668
Managed	.397	.421	.453	.499	.563	.630	.699	.771	.836	.916
Pure	.394	.406	.434	.463	.527	.596	.690	.823	.976	1.185
Currency deposit ratio (percent change):										
Baseline	1.5	3.3	5.7	5.6	8.4	7.9	6.6	6.2	4.8	6.0
Managed	2.3	6.0	7.6	10.2	12.8	11.9	10.9	10.3	8.4	9.6
Pure	1.5	3.0	7.0	6.7	13.8	13.1	15.8	19.3	18.6	21.4

TABLE APPENDIX A.2.2.—DRI LONG TERM ANNUAL MODEL: GRADUAL DECLERATION TO 0 PERCENT ANNUAL M_1 GROWTH: STRATEGY 2 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Nominal GNP (percent change):										
Baseline	6.0	11.2	11.4	11.6	11.0	10.1	10.3	9.7	9.1	9.0
Managed	5.0	10.5	9.5	9.7	9.6	8.1	7.8	7.5	6.8	6.4
Pure	6.0	10.6	10.6	9.3	10.6	9.3	11.3	11.6	11.1	11.0
Real GNP (percent change):										
Baseline	−1.4	3.6	4.0	4.0	3.5	3.0	3.4	3.1	2.5	2.7
Managed	−2.2	3.1	2.6	3.4	4.0	3.5	3.6	3.6	2.8	2.7
Pure	−1.4	3.0	3.4	2.3	3.5	2.6	4.4	4.4	3.4	3.1
GNP deflator (percent change):										
Baseline	7.4	7.4	7.1	7.3	7.3	6.9	6.6	6.4	6.5	6.2
Managed	7.4	7.2	6.7	6.1	5.4	4.5	4.0	3.8	3.9	3.6
Pure	7.4	7.3	7.0	6.9	7.0	6.6	6.6	6.9	7.5	7.7
Personal consumption deflator (percent change):										
Baseline	6.6	6.8	6.7	6.9	7.0	6.9	6.6	6.4	6.5	6.2
Managed	6.6	6.6	6.2	5.8	5.2	4.6	4.2	3.9	4.0	3.8
Pure	6.6	6.7	6.5	6.6	6.8	6.8	6.9	7.2	7.7	7.8
Index of hourly earnings (percent change):										
Baseline	7.4	7.2	7.7	7.8	7.9	8.0	8.0	7.9	7.8	7.8
Managed	7.4	6.9	7.0	5.7	4.5	4.5	4.5	4.5	4.5	4.5
Pure	7.4	7.2	7.6	7.5	7.6	7.7	8.0	8.3	8.7	8.9

TABLE APPENDIX A.2.3.—DRI LONG TERM ANNUAL MODEL: GRADUAL DECELERATION TO 0 PERCENT ANNUAL M_1 GROWTH: STRATEGY 2 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Unemployment rate:										
Baseline	9.2	8.8	8.0	7.5	7.1	6.9	6.7	6.5	6.5	6.5
Managed	9.6	9.6	9.4	9.1	8.3	7.5	7.0	6.6	6.4	6.4
Pure	9.2	9.0	8.5	8.5	8.3	8.1	7.4	6.4	5.7	5.3
3-month T-bill rate:										
Baseline	11.94	12.35	11.23	10.27	11.27	10.73	9.71	9.31	8.77	8.63
Managed	14.48	14.46	12.65	10.55	10.05	9.13	7.88	7.47	7.02	6.93
Pure	11.94	14.64	15.00	22.32	23.20	30.31	36.37	36.41	35.71	34.32
3-month commercial paper rate:										
Baseline	12.78	13.51	12.11	10.96	12.19	11.54	10.30	9.84	9.26	9.15
Managed	15.32	15.52	13.35	10.96	10.57	9.50	8.03	7.57	7.08	7.00
Pure	12.78	15.83	15.90	23.06	24.05	31.02	36.85	36.75	35.95	34.60
Corporate bond rate:										
Baseline	14.27	13.38	12.16	11.66	11.81	11.78	11.62	11.43	11.13	10.88
Managed	15.04	14.58	12.04	12.39	11.59	10.53	10.99	10.08	9.53	9.51
Pure	14.27	14.08	13.22	15.21	17.33	21.81	26.95	29.90	28.70	24.66
Mortgage interest rate:										
Baseline	16.51	15.75	15.01	14.67	14.73	14.34	14.04	13.77	13.42	13.07
Managed	17.20	16.82	14.90	15.32	14.53	13.23	13.49	12.57	12.00	11.86
Pure	16.51	16.37	15.95	17.83	19.65	23.27	27.69	30.22	29.07	25.35
Federal deficit:										
Baseline	−135.8	−140.9	−130.3	−105.3	−105.1	−104.0	−90.1	−72.4	−47.1	−45.7
Managed	−146.5	−162.4	−174.5	−163.7	−156.0	−145.3	−128.9	−104.8	−79.2	−83.3
Pure	−135.8	−149.9	−154.9	−177.6	−213.1	−270.0	−315.4	−356.1	−392.2	−457.8

TABLE APPENDIX A.2.4.—DRI LONG TERM ANNUAL MODEL: GRADUAL ACCELERATION TO 10 PERCENT ANNUAL M_1 GROWTH; STRATEGY 4 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
M_1 (percent change):										
Baseline	5.6	5.1	4.6	5.5	4.0	4.0	4.6	4.2	4.0	3.8
Managed	6.0	7.0	8.0	9.0	10.0	10.0	10.0	10.0	10.0	10.0
Pure	5.6	6.4	7.3	8.2	9.2	9.9	9.9	10.1	10.0	10.0
M_2 (percent change):										
Baseline	8.3	8.9	9.2	10.8	9.5	9.8	9.1	8.2	8.0	7.7
Managed	11.0	11.6	12.2	12.8	13.1	13.1	13.1	13.1	13.1	13.1
Pure	8.3	11.1	14.4	15.2	16.5	19.0	14.7	13.6	14.2	13.2
Nonborrowed reserves (percent change):										
Baseline	4.6	5.5	5.9	5.2	5.1	6.6	6.7	6.7	6.9	6.5
Managed	8.4	8.8	8.2	9.2	10.2	10.1	10.1	10.1	10.1	10.0
Pure	4.6	21.1	18.4	7.1	21.7	14.4	6.1	10.5	10.6	10.6
M_1 velocity (percent change):										
Baseline	.3	5.9	6.5	5.8	6.8	5.9	5.4	5.3	4.9	5.0
Managed	1.6	6.0	5.9	3.5	2.9	2.9	3.8	4.2	3.1	2.1
Pure	.3	5.7	6.0	5.8	6.6	5.0	5.5	4.3	2.5	2.0
M_2 velocity (percent change):										
Baseline	−2.1	2.2	2.0	.7	1.4	.3	1.1	1.4	1.1	1.2
Managed	−3.0	1.6	2.0	0	.1	0	.9	1.3	.3	−.7
Pure	−2.1	1.2	−.6	−.6	0	−3.0	1.0	1.0	−1.3	−.9
Currency deposit ratio (level):										
Baseline	.394	.407	.430	.454	.492	.531	.566	.601	.630	.668
Managed	.399	.411	.428	.437	.449	.465	.482	.501	.508	.513
Pure	.394	.406	.423	.437	.464	.484	.506	.525	.531	.537
Currency deposit ratio (percent change):										
Baseline	1.5	3.3	5.7	5.6	8.4	7.9	6.6	6.2	4.8	6.0
Managed	2.8	3.0	4.1	2.1	2.7	3.6	3.7	3.9	1.4	1.0
Pure	1.5	3.0	4.2	3.3	6.2	4.3	4.5	3.8	1.1	1.1

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TABLE APPENDIX A.2.5.—DRI LONG TERM ANNUAL MODEL: GRADUAL ACCELERATION TO 10 PERCENT ANNUAL M_1 STRATEGY 4 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Nominal GNP (percent change):										
Baseline	6.0	11.2	11.4	11.6	11.0	10.1	10.3	9.7	9.1	9.0
Managed	7.7	13.4	14.4	12.8	13.2	13.2	14.1	14.6	13.5	12.3
Pure	6.0	12.5	13.8	14.5	16.4	15.4	15.9	14.7	12.8	12.2
Real GNP (percent change):										
Baseline	−1.4	3.6	4.0	[illegible]	3.5	3.0	3.4	3.1	2.5	2.7
Managed	−.6	4.3	4.9	[illegible]	2.7	2.4	3.2	3.5	2.7	2.2
Pure	−1.4	4.6	5.7	[illegible]	6.0	4.3	4.1	3.3	2.2	2.5
GNP deflator (percent change):										
Baseline	7.4	7.4	7.1	[illegible]	7.3	6.9	6.6	6.4	6.5	6.2
Managed	8.2	8.7	9.0	[illegible]	10.2	10.5	10.6	10.7	10.4	9.8
Pure	7.4	7.5	7.6	[illegible]	9.9	10.6	11.3	11.1	10.3	9.4
Personal consumption deflator (percent change):										
Baseline	6.6	6.8	6.7	6.9	7.0	6.9	6.6	6.4	6.5	6.2
Managed	7.3	7.9	8.4	8.7	9.7	10.2	10.4	10.4	10.2	9.7
Pure	6.6	6.9	7.1	8.0	9.6	10.7	11.4	11.2	10.4	9.4
Index of hourly earnings (percent change):										
Baseline	7.4	7.2	7.7	7.8	7.9	8.0	8.0	7.9	7.8	7.8
Managed	8.9	9.2	10.3	10.1	12.8	13.1	13.3	13.5	12.4	12.7
Pure	7.4	7.3	8.0	8.5	9.7	10.8	11.6	11.7	11.0	10.3

TABLE APPENDIX A.2.6.—DRI LONG TERM ANNUAL MODEL: GRADUAL ACCELERATION TO 10 PERCENT ANNUAL M_1 GROWTH: STRATEGY 4 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Unemployment rate:										
Baseline	9.2	8.8	8.0	7.5	7.1	6.9	6.7	6.5	6.5	6.5
Managed	8.8	8.0	6.6	6.4	6.6	7.0	7.0	6.7	6.5	6.6
Pure	9.2	8.5	7.1	6.0	4.8	4.2	3.9	3.9	4.3	4.8
3-mo T-bill rate:										
Baseline	11.94	12.35	11.23	10.27	11.27	10.73	9.71	9.31	8.77	8.63
Managed	10.54	10.85	9.85	9.42	12.09	12.95	12.04	11.51	10.91	11.64
Pure	11.94	9.13	6.08	5.95	4.23	3.90	4.94	4.99	5.10	5.27
3-mo commercial paper rate:										
Baseline	12.78	13.51	12.11	10.96	12.19	11.54	10.30	9.84	9.26	9.15
Managed	11.35	12.00	10.75	10.14	13.06	13.82	12.69	12.06	11.39	12.16
Pure	12.78	10.26	6.94	6.69	5.25	4.92	5.88	5.98	6.13	6.35
Corporate bond rate:										
Baseline	14.27	13.38	12.16	11.66	11.81	11.78	11.62	11.43	11.13	10.88
Managed	13.91	12.87	12.22	11.43	12.44	13.92	15.41	15.68	14.66	14.08
Pure	14.27	12.41	10.85	10.62	9.62	10.05	11.03	11.91	12.21	11.66
Mortgage interest rate:										
Baseline	16.51	15.75	15.01	14.67	14.73	14.34	14.04	13.77	13.42	13.07
Managed	16.19	15.29	15.06	14.46	15.29	16.24	17.42	17.56	16.56	15.93
Pure	16.51	14.88	13.84	13.74	12.79	12.80	13.52	14.20	14.38	13.77
Federal deficit:										
Baseline	−135.8	−140.9	−130.3	−105.3	−105.1	−104.0	−90.1	−72.4	−47.1	−45.7
Managed	−125.2	−115.4	−81.1	−54.9	−64.7	−75.6	−61.4	−23.0	32.9	37.4
Pure	−135.8	−125.6	−81.4	−14.0	59.8	131.9	217.4	297.5	376.0	430.0

TABLE APPENDIX A.2.7.—DRI LONG TERM ANNUAL MODEL: SUDDEN DECELERATION TO 0 PERCENT ANNUAL M_1 GROWTH: STRATEGY 1 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
M_1 (percent change):										
Baseline	5.6	5.1	4.6	5.5	4.0	4.0	4.6	4.2	4.0	3.8
Managed	2.5	0	0	0	0	0	0	0	0	0
Pure	4.7	2.5	0	.1	−.1	0		Model breaks down		
M_2 (percent change):										
Baseline	8.3	8.9	9.2	10.8	9.5	9.8	9.1	8.2	8.0	7.7
Managed	5.7	6.0	6.3	6.5	6.0	5.6	5.6	5.6	5.6	5.6
Pure	6.7	4.3	1.8	3.9	8.2	12.3		Model breaks down		
Nonborrowed reserves (percent change):										
Baseline	4.6	5.5	5.9	5.2	5.1	6.6	6.7	6.7	6.9	6.5
Managed	−1.6	3.3	3.3	3.6	3.5	3.4	3.4	3.3	3.2	3.1
Pure	−8.8	−37.1	−127.3	−555.3	−31.0	−91.1		Model breaks down		
M_1 velocity (percent change):										
Baseline	.3	5.9	6.5	5.8	6.8	5.9	5.4	5.3	4.9	5.0
Managed	.4	8.9	8.6	10.5	9.9	7.9	7.8	7.4	6.6	6.2
Pure	.4	6.7	9.5	12.6	15.9	15.9		Model breaks down		
M_2 velocity (percent change):										
Baseline	−2.1	2.2	2.0	.7	1.4	.3	1.1	1.4	1.1	1.2
Managed	−2.6	2.8	2.1	3.8	3.7	2.2	2.1	1.7	.9	.6
Pure	−1.5	4.9	7.4	8.5	7.0	3.3		Model breaks down		
Currency deposit ratio (level):										
Baseline	.394	.407	.430	.454	.492	.531	.566	.601	.630	.668
Managed	.396	.432	.475	.535	.605	.673	.745	.821	.887	.969
Pure	.394	.410	.446	.509	.626	.754		Model breaks down		
Currency deposit ratio (percent change):										
Baseline	1.5	3.3	5.7	5.6	8.4	7.9	6.6	6.2	4.8	6.0
Managed	2.1	9.1	10.0	12.6	13.1	11.2	10.7	10.2	8.0	9.2
Pure	1.5	4.1	8.8	14.1	23.0	20.4		Model breaks down		

TABLE APPENDIX A.2.8.—DRI LONG TERM ANNUAL MODEL: SUDDEN DECELERATION TO 0 PERCENT ANNUAL M_1 GROWTH: STRATEGY 1 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Nominal GNP (percent change):										
Baseline	6.0	11.2	11.4	11.6	11.0	10.1	10.3	7.9	9.1	9.0
Managed	2.9	8.9	8.6	10.5	9.9	7.9	7.8	7.4	6.6	6.2
Pure	5.1	9.3	9.4	12.7	15.8	16.0		Model breaks down		
Real GNP (percent change):										
Baseline	−1.4	3.6	4.0	4.0	3.5	3.0	3.4	3.1	2.5	2.7
Managed	−3.3	2.6	2.9	4.9	4.5	3.3	3.5	3.3	2.6	2.5
Pure	−2.1	2.0	2.5	5.1	7.0	5.9		Model breaks down		
GNP deflator (percent change):										
Baseline	7.4	7.4	7.1	7.3	7.3	6.9	6.6	6.4	6.5	6.2
Managed	6.4	6.2	5.6	5.4	5.2	4.4	4.1	3.9	3.9	3.6
Pure	7.3	7.2	6.8	7.2	8.3	9.5		Model breaks down		
Personal consumption deflator (percent change):										
Baseline	6.6	6.8	6.7	6.9	7.0	6.9	6.6	6.4	6.5	6.2
Managed	5.9	5.7	5.2	5.1	4.9	4.5	4.2	3.9	4.0	3.7
Pure	6.6	6.7	6.6	7.3	8.6	10.2		Model breaks down		
Index of hourly earnings (percent change):										
Baseline	7.4	7.2	7.7	7.8	7.9	8.0	8.0	7.9	7.8	7.8
Managed	5.6	5.6	5.5	5.0	4.5	4.5	4.5	4.4	4.4	4.4
Pure	7.4	7.1	7.6	7.8	8.7	10.0		Model breaks down		

TABLE APPENDIX A.2.9.—DRI LONG TERM ANNUAL MODEL: SUDDEN DECELERATION TO 0 PERCENT ANNUAL M_1 GROWTH: STRATEGY 1 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Unemployment rate:										
Baseline	9.2	8.8	8.0	7.5	7.1	6.9	6.7	6.5	6.5	6.5
Managed	10.1	10.6	10.4	9.3	8.0	7.1	6.7	6.4	6.4	6.5
Pure	9.4	9.7	9.5	8.7	6.9	5.2		Model breaks down		
3-mo T-bill rate:										
Baseline	11.94	12.35	11.23	10.27	11.27	10.73	9.71	9.31	8.77	8.63
Managed	15.48	15.16	13.05	10.70	10.05	9.07	7.87	7.45	6.94	6.84
Pure	14.87	23.16	37.09	52.09	56.89	75.82		Model breaks down		
3-mo commercial paper rate:										
Baseline	12.78	13.51	12.11	10.96	12.19	11.54	10.30	9.84	9.26	9.15
Managed	16.34	16.24	13.75	11.12	10.65	9.57	8.18	7.73	7.21	7.15
Pure	15.74	24.40	38.10	52.90	57.83	76.83		Model breaks down		
Corporate bond rate:										
Baseline	14.27	13.38	12.16	11.66	11.81	11.78	11.62	11.43	11.13	10.88
Managed	15.25	14.85	11.92	12.47	11.62	10.40	11.04	10.15	9.51	9.54
Pure	15.17	17.40	22.38	31.85	40.74	50.86		Model breaks down		
Mortgage interest rate:										
Baseline	16.51	15.75	15.01	14.67	14.73	14.34	14.04	13.77	13.42	13.07
Managed	17.39	17.06	14.80	15.39	14.56	13.11	13.53	12.63	11.98	11.88
Pure	17.31	19.32	24.11	32.64	40.49	49.14		Model breaks down		
Federal deficit:										
Baseline	−135.8	−140.9	−130.3	−105.3	−105.1	−104.0	−90.1	−72.4	−47.1	−45.7
Managed	−161.0	−189.0	−204.9	−178.0	−161.7	−151.9	−134.3	−111.4	−86.8	−91.7
Pure	−146.6	−185.0	−240.4	−293.4	−355.2	−464.4		Model breaks down		

TABLE APPENDIX A.2.10.—DRI LONG TERM ANNUAL MODEL: SUDDEN DECELERATION TO 3 PERCENT ANNUAL M_1 GROWTH: STRATEGY 3 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
M_1 (percent change):										
Baseline	5.6	5.1	4.6	5.5	4.0	4.0	4.6	4.2	4.0	3.8
Managed	4.2	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Pure	4.0	3.1	2.9	3.1	2.9	3.0	3.1	2.9	3.0	3.0
M_2 (percent change):										
Baseline	8.3	8.9	9.2	10.8	9.5	9.8	9.1	8.2	8.0	7.7
Managed	7.4	7.7	8.1	9.1	8.8	8.1	7.7	7.5	7.2	6.8
Pure	5.6	5.1	7.8	8.8	9.5	11.9	8.3	7.6	9.0	9.2
Nonborrowed reserves (percent change):										
Baseline	4.6	5.5	5.9	5.2	5.1	6.6	6.7	6.7	6.9	6.5
Managed	−.1	5.0	5.0	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Pure	−20.3	−13.9	11.6	−22.0	44.4	14.5	--6.4	12.1	17.8	13.1
M_1 velocity (percent change):										
Baseline	.3	5.9	6.5	5.8	6.8	5.9	5.4	5.3	4.9	5.0
Managed	1.0	6.9	7.0	7.4	7.9	6.6	6.1	6.5	5.6	5.1
Pure	.4	7.1	8.2	7.7	8.6	7.1	7.2	7.1	6.3	6.5
M_2 velocity (percent change):										
Baseline	−2.1	2.2	2.0	.7	1.4	.3	1.1	1.4	1.1	1.2
Managed	−2.1	2.2	2.0	1.4	2.1	1.6	1.4	2.0	1.5	1.4
Pure	−1.1	5.1	3.3	2.0	2.1	−1.4	2.0	2.4	.5	.5
Currency deposit ratio (level):										
Baseline	.394	.407	.430	.454	.492	.531	.566	.601	.630	.668
Managed	.398	.420	.449	.486	.533	.581	.626	.676	.717	.765
Pure	.394	.416	.454	.491	.553	.611	.666	.733	.793	.866
Currency deposit ratio (percent change):										
Baseline	1.5	3.3	5.7	5.6	8.4	7.9	6.6	6.2	4.8	6.0
Managed	2.6	5.5	6.9	8.2	9.7	9.0	7.7	8.0	6.1	6.7
Pure	1.5	5.6	9.1	8.1	12.6	10.5	9.0	10.1	8.2	9.3

TABLE APPENDIX A.2.11.—DRI LONG TERM ANNUAL MODEL: SUDDEN DECELERATION TO 3 PERCENT ANNUAL M_1 GROWTH: STRATEGY 3 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Nominal GNP (percent change):										
Baseline	6.0	11.2	11.4	11.6	11.0	10.1	10.3	9.7	9.1	9.0
Managed	5.2	10.1	10.3	10.6	11.1	9.8	9.3	9.6	8.8	8.2
Pure	4.4	10.4	11.4	11.0	11.8	10.4	10.5	10.2	9.5	9.8
Real GNP (percent change):										
Baseline	−1.4	3.6	4.0	4.0	3.5	3.0	3.4	3.1	2.5	2.7
Managed	−1.7	3.2	3.8	3.9	4.2	3.2	3.0	3.4	2.4	2.3
Pure	−2.7	2.9	4.0	3.5	4.2	3.1	3.5	3.2	2.4	2.8
GNP deflator (percent change):										
Baseline	7.4	7.4	7.1	7.3	7.3	6.9	6.6	6.4	6.5	6.2
Managed	6.9	6.7	6.2	6.5	6.7	6.4	6.1	6.1	6.2	5.8
Pure	7.3	7.3	7.1	7.2	7.3	7.0	6.8	6.7	6.9	6.8
Personal consumption deflator (percent change):										
Baseline	6.6	6.8	6.7	6.9	7.0	6.9	6.6	6.4	6.5	6.2
Managed	6.3	6.2	5.8	6.1	6.4	6.4	6.2	6.1	6.2	5.9
Pure	6.6	6.7	6.7	6.9	7.1	7.0	6.8	6.7	6.9	6.7
Index of hourly earnings (percent change):										
Baseline	7.4	7.2	7.7	7.8	7.9	8.0	8.0	7.9	7.8	7.8
Managed	6.6	6.2	6.5	6.7	6.9	7.2	7.2	7.3	7.2	7.2
Pure	7.4	7.2	7.7	7.7	7.8	8.0	8.0	8.1	8.1	8.1

TABLE APPENDIX A.2.12.—DRI LONG TERM ANNUAL MODEL: SUDDEN DECELERATION TO 3 PERCENT ANNUAL M_1 GROWTH: STRATEGY 3 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Unemployment rate:										
Baseline	9.2	8.8	8.0	7.5	7.1	6.9	6.7	6.5	6.5	6.5
Managed	9.4	9.3	8.6	8.0	7.2	6.7	6.5	6.3	6.2	6.3
Pure	9.6	9.6	8.9	8.3	7.6	7.1	6.7	6.4	6.2	6.1
3-mo T-bill rate:										
Baseline	11.94	12.35	11.23	10.27	11.27	10.73	9.71	9.31	8.77	8.63
Managed	13.91	13.87	12.46	10.62	11.08	10.36	9.26	8.97	8.55	8.36
Pure	17.47	20.42	17.99	20.71	16.96	15.68	16.72	15.39	13.42	2.49
3-mo commercial paper rate:										
Baseline	12.78	13.51	12.11	10.96	12.19	11.54	10.30	9.84	9.26	9.15
Managed	14.75	14.97	13.21	11.13	11.80	10.97	9.68	9.34	8.90	8.74
Pure	18.38	21.59	18.77	21.28	17.67	16.26	17.12	15.74	13.73	12.84
Corporate bond rate:										
Baseline	14.27	13.38	12.16	11.66	11.81	11.78	11.62	11.43	11.13	10.88
Managed	14.83	14.17	12.05	12.16	11.86	11.16	11.67	11.30	10.86	10.72
Pure	15.96	17.33	15.87	15.48	15.16	14.19	15.21	14.94	13.94	3.36
Mortgage interest rate:										
Baseline	16.51	15.75	15.01	14.67	14.73	14.34	14.04	13.77	13.42	13.07
Managed	17.01	16.44	14.91	15.11	14.78	13.78	14.09	13.65	13.18	12.93
Pure	18.02	19.27	18.31	18.07	17.71	16.48	17.25	16.9	15.93	5.29
Federal deficit:										
Baseline	−135.8	−140.9	−130.3	−105.3	−105.1	−104.0	−90.1	−72.4	−47.1	−45.7
Managed	−143.5	−158.5	−157.4	−137.0	−128.2	−123.0	−116.4	−94.8	−71.6	−80.8
Pure	−155.0	−182.7	−188.7	−192.9	−201.6	−210.1	−211.5	−207.0	191.4	−191.2

TABLE APPENDIX A.3.1.—WHARTON ANNUAL MODEL: GRADUAL DECELERATION TO 4 PERCENT ANNUAL M_2 GROWTH: STRATEGY 2 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
M_1 (percent change):										
Baseline	5.82	5.22	5.20	5.60	5.55	5.58	4.04	5.24	4.34	5.52
Managed	5.82	3.77	1.94	1.28	1.01	1.92	3.85	2.41	.52	−1.30
Pure	5.82	4.13	1.58	−1.87	−4.80	−6.98	−6.67	Model breaks down		
M_2 (percent change):										
Baseline	8.82	8.56	9.23	10.91	10.80	10.49	9.22	10.02	9.42	10.01
Managed	8.82	7.80	6.80	5.80	4.80	4.00	4.00	4.00	4.00	4.00
Pure	8.82	7.80	6.80	5.80	4.80	4.00	4.00	Model breaks down		
Nonborrowed reserves (percent change):										
Baseline	10.61	−2.53	1.30	10.92	14.82	13.50	7.19	7.13	6.66	7.08
Managed	10.61	−3.73	−3.19	2.11	4.48	4.58	3.69	.60	−.38	−5.71
Pure	10.61	−4.00	−4.04	−1.61	−3.95	−11.56	−19.34	Model breaks down		
M_1 velocity (percent change):										
Baseline	.93	5.89	5.36	5.30	3.68	5.00	5.38	4.33	4.86	3.55
Managed	.93	5.59	6.98	8.11	7.22	6.42	2.29	3.92	4.72	6.81
Pure	.93	7.00	8.70	11.14	13.79	19.52	16.43	Model breaks down		
M_2 velocity (percent change):										
Baseline	−1.85	2.64	1.47	.26	−1.23	.33	.38	.20	−.01	−.68
Managed	−1.85	1.65	2.11	3.49	3.34	4.29	2.14	2.33	1.21	1.37
Pure	−1.85	3.36	3.39	3.08	3.36	6.90	4.48	Model breaks down		
Currency deposit ratio (level):										
Baseline	.388	.399	.417	.436	.456	.483	.516	.545	.579	.604
Managed	.388	.396	.422	.461	.510	.558	.582	.609	.646	.709
Pure	.388	.404	.439	.493	.588	.767	.994	Model breaks down		
Currency deposit ratio (percent change):										
Baseline	0	2.8	4.5	4.6	4.7	5.9	6.8	7.0	6.2	4.3
Managed	0	2.1	6.6	9.2	10.6	9.4	4.3	4.6	6.1	9.8
Pure	0	4.1	8.7	12.3	19.3	30.4	29.6	Model breaks down		

TABLE APPENDIX A.3.2.—WHARTON ANNUAL MODEL: GRADUAL DECELERATION TO 4 PERCENT ANNUAL M_2 GROWTH: STRATEGY 2 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Nominal GNP (percent change):										
Baseline	6.81	11.42	10.83	11.20	9.44	10.86	9.64	9.80	9.41	9.27
Managed	6.80	9.57	9.06	9.49	8.30	8.46	6.23	6.43	5.26	5.43
Pure	6.80	11.42	10.42	9.06	8.32	11.18	8.66	Model breaks down		
Real GNP (percent change):										
Baseline	−1.40	3.85	3.89	3.75	1.97	3.40	2.76	3.10	2.82	2.91
Managed	−1.40	2.15	2.34	3.55	3.11	3.68	2.00	3.00	2.70	3.02
Pure	−1.40	3.85	3.49	1.72	.74	3.61	1.98	Model breaks down		
GNP deflator (percent change):										
Baseline	8.32	7.28	6.68	7.18	7.32	7.21	6.69	6.50	6.41	6.18
Managed	8.32	7.26	6.57	5.74	5.04	4.61	4.14	3.32	2.49	2.34
Pure	8.32	7.28	6.69	7.21	7.53	7.31	6.55	Model breaks down		
Personal consumption deflator (percent change):										
Baseline	7.49	7.04	6.89	7.13	6.96	6.71	5.81	5.90	5.47	5.51
Managed	7.50	6.99	6.73	5.90	4.96	4.60	3.65	3.05	1.99	2.45
Pure	7.50	7.04	6.91	7.24	7.20	6.74	5.76	Model breaks down		
CPI (percent change):										
Baseline	6.85	6.44	5.84	6.60	6.79	7.09	6.48	6.82	6.57	6.08
Managed	6.86	6.34	5.62	5.30	4.81	4.70	4.10	3.83	2.96	3.15
Pure	6.86	6.45	5.82	6.58	6.93	7.08	6.31	Model breaks down		
Average wage (percent change):										
Baseline	9.52	7.39	6.95	9.46	9.32	8.64	8.34	8.48	8.16	7.52
Managed	9.52	7.28	6.33	6.85	5.95	4.96	4.60	3.56	2.17	1.73
Pure	9.52	7.39	6.97	9.54	9.40	8.54	8.33	Model breaks down		

TABLE APPENDIX A.3.3.—WHARTON ANNUAL MODEL: GRADUAL DECELERATION TO 4 PERCENT ANNUAL M_2 GROWTH: STRATEGY 2 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Unemployment rate:										
Baseline	9.21	8.60	7.74	7.11	7.10	6.53	6.54	6.35	6.32	6.09
Managed	9.21	9.38	9.52	9.40	8.96	8.00	8.13	8.01	7.85	7.58
Pure	9.21	8.60	7.94	8.41	9.47	9.23	9.69	Model breaks down		
3-mo T-bill yield:										
Baseline	12.67	14.00	12.04	10.79	9.59	9.44	9.21	8.80	8.58	8.23
Managed	12.67	15.01	13.64	10.68	8.88	7.46	5.39	5.48	5.46	5.69
Pure	12.67	14.52	13.99	14.96	17.35	22.60	25.92	Model breaks down		
Commercial paper rate:										
Baseline	13.74	15.19	12.86	11.50	10.21	10.05	9.79	9.36	9.12	8.74
Managed	13.74	16.28	14.59	11.39	9.44	7.91	5.67	5.77	5.75	5.99
Pure	13.74	15.75	14.96	15.95	18.60	24.26	27.85	Model breaks down		
Corporate bond rate:										
Baseline	16.02	15.86	14.51	14.23	13.59	13.08	12.65	12.12	11.91	11.67
Managed	16.02	16.82	15.63	13.65	11.83	10.09	8.22	7.36	7.32	7.37
Pure	16.02	15.86	15.26	16.28	17.99	21.23	25.20	Model breaks down		
Mortgage interest rate:										
Baseline	15.75	14.88	12.60	12.29	11.62	11.06	10.60	10.04	9.82	9.56
Managed	15.75	15.90	13.78	11.69	9.19	7.87	5.88	4.96	4.91	4.97
Pure	15.75	15.04	13.40	14.48	16.32	19.77	24.02	Model breaks down		
Government surplus or deficit:										
Baseline	−132.72	−134.61	−138.11	−101.58	−103.14	−91.31	−83.62	−75.98	−49.66	−38.14
Managed	−132.72	−158.74	−190.26	−170.85	−161.50	−144.86	−131.08	−95.29	−92.53	−93.46
Pure	−132.72	−134.61	−145.99	−148.67	−189.12	−208.82	−277.48	Model breaks down		

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TABLE APPENDIX A.3.4.—WHARTON ANNUAL MODEL: GRADUAL ACCELERATION TO 14 PERCENT ANNUAL M_2 GROWTH: STRATEGY 4 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
M_1 (percent change):										
Baseline	5.82	5.22	5.20	5.60	5.55	5.58	4.04	5.24	4.34	5.52
Managed	5.82	7.40	7.56	6.19	6.19	7.01	4.19	6.57	5.91	8.86
Pure	5.82	7.19	7.89	7.82	9.52	12.45		Model breaks down		
M_2 (percent change):										
Baseline	8.82	8.56	9.23	10.91	10.80	10.49	9.22	10.02	9.42	10.01
Managed	8.82	9.90	11.00	12.00	13.00	14.00	14.00	14.00	14.00	14.00
Pure	8.82	9.90	11.00	12.00	13.00	14.00		Model breaks down		
Nonborrowed reserves (percent change):										
Baseline	10.61	−2.53	1.30	10.92	14.82	13.50	7.19	7.13	6.66	7.08
Managed	10.61	.01	5.06	12.59	16.73	16.65	9.54	9.83	9.86	11.18
Pure	10.61	.10	5.10	14.54	21.23	24.08		Model breaks down		
M_1 velocity (percent change):										
Baseline	.93	5.89	5.36	5.30	3.68	5.00	5.38	4.33	4.86	3.55
Managed	.93	4.50	3.21	5.48	4.59	5.37	7.83	4.97	6.30	3.79
Pure	.93	3.95	3.63	3.83	.99	−.04		Model breaks down		
M_2 velocity (percent change):										
Baseline	−1.85	2.64	1.47	.26	−1.23	.33	.38	.20	−.01	−.68
Managed	−1.85	2.12	.01	0	−1.72	−1.09	−1.44	−1.87	−1.24	−.89
Pure	−1.85	1.38	.73	−.05	−2.11	−1.40		Model breaks down		
Currency deposit ratio (level):										
Baseline	.388	.399	.417	.436	.456	.483	.516	.545	.579	.604
Managed	.388	.393	.399	.416	.438	.466	.508	.540	.583	.613
Pure	.388	.389	.399	.410	.415	.415		Model breaks down		
Currency deposit ratio:										
Baseline	0	2.8	4.5	4.6	4.7	5.9	6.8	7.0	6.2	4.3
Managed	0	1.3	1.5	4.3	5.4	6.4	9.0	6.3	8.0	5.1
Pure	0	.3	2.6	2.8	1.2	0		Model breaks down		

TABLE APPENDIX A.3.5.—WHARTON ANNUAL MODEL: GRADUAL ACCELERATION TO 14 PERCENT ANNUAL M_1 GROWTH: STRATEGY 4 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Nominal GNP (percent change):										
Baseline	6.81	11.42	10.83	11.20	9.44	10.86	9.64	9.80	9.41	9.27
Managed	6.80	12.23	11.01	12.00	11.06	12.76	12.35	11.86	12.59	12.99
Pure	6.80	11.42	11.81	11.94	10.61	12.40	Model breaks down			
Real GNP (percent change):										
Baseline	−1.40	3.85	3.89	3.75	1.97	3.40	2.76	3.10	2.82	2.91
Managed	−1.40	4.39	3.36	3.03	1.80	3.07	2.74	2.00	2.19	2.45
Pure	−1.40	3.85	4.81	4.54	3.15	4.92	Model breaks down			
GNP deflator (percent change):										
Baseline	8.32	7.28	6.68	7.18	7.32	7.21	6.69	6.50	6.41	6.18
Managed	8.33	7.51	7.40	8.71	9.10	9.40	9.36	9.67	10.18	10.29
Pure	8.32	7.28	6.68	7.08	7.24	7.13	Model breaks down			
Personal consumption deflator (percent change):										
Baseline	7.49	7.04	6.89	7.13	6.96	6.71	5.81	5.90	5.47	5.51
Managed	7.50	7.22	7.54	8.47	8.47	8.60	8.11	8.63	8.66	8.78
Pure	7.50	7.04	6.86	7.04	6.84	6.62	Model breaks down			
CPI (percent change):										
Baseline	6.85	6.44	5.84	6.60	6.79	7.09	6.48	6.82	6.57	6.08
Managed	6.86	6.67	6.50	7.99	8.38	9.06	8.88	9.59	9.82	9.75
Pure	6.85	6.45	5.86	6.55	6.75	7.11	Model breaks down			
Average wage (percent change):										
Baseline	9.52	7.39	6.95	9.46	9.32	8.64	8.34	8.48	8.16	7.52
Managed	9.52	7.71	8.12	11.73	11.72	11.87	12.34	13.07	13.37	13.17
Pure	9.52	7.39	6.91	9.43	9.31	8.66	Model breaks down			

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TABLE APPENDIX A.3.6.—WHARTON ANNUAL MODEL: GRADUAL ACCELERATION TO 14 PERCENT ANNUAL M_3 GROWTH: STRATEGY 4 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Unemployment rate:										
Baseline	9.21	8.60	7.74	7.11	7.10	6.53	6.54	6.35	6.32	6.09
Managed	9.21	8.32	7.60	7.41	7.74	7.53	7.75	8.24	8.81	9.09
Pure	9.21	8.60	7.28	6.06	5.19	3.05		Model breaks down		
3-mo T-bill yield:										
Baseline	12.67	14.00	12.04	10.79	9.59	9.44	9.21	8.80	8.58	8.23
Managed	12.67	12.85	10.91	10.77	10.50	11.00	13.73	12.97	14.10	12.75
Pure	12.67	13.10	10.59	9.07	7.24	5.83		Model breaks down		
Commercial paper rate:										
Baseline	13.74	15.19	12.86	11.50	10.21	10.05	9.79	9.36	9.12	8.74
Managed	13.74	13.95	11.63	11.48	11.19	11.73	14.67	13.86	15.07	13.62
Pure	13.74	14.22	11.29	9.65	7.66	6.14		Model breaks down		
Corporate bond rate:										
Baseline	16.02	15.86	14.51	14.23	13.59	13.08	12.65	12.12	11.91	11.67
Managed	16.02	16.01	14.24	13.94	13.81	14.15	15.64	16.43	17.08	16.53
Pure	16.02	15.86	13.77	12.94	11.72	10.45		Model breaks down		
Mortgage interest rate:										
Baseline	15.75	14.88	12.60	12.29	11.62	11.06	10.60	10.04	9.82	9.56
Managed	15.75	15.03	12.30	11.98	11.85	12.21	13.80	14.64	15.34	14.75
Pure	15.75	14.60	11.80	10.91	9.62	8.25		Model breaks down		
Government surplus or deficit:										
Baseline	−132.72	−134.61	−138.11	−101.58	−103.14	−91.31	−83.62	−75.98	−49.66	−38.14
Managed	−132.72	−126.15	−130.24	−95.44	−94.39	−84.72	−78.86	−101.64	−91.53	−94.51
Pure	−132.72	−134.61	−122.58	−69.17	−42.95	8.27		Model breaks down		

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TABLE APPENDIX A.3.7.—WHARTON ANNUAL MODEL: SUDDEN DECELERATION TO 4 PERCENT ANNUAL M_2 GROWTH: STRATEGY 1 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
M_1 (percent change):										
Baseline	5.82	5.22	5.20	5.60	5.55	5.58	4.04	5.24	4.34	5.52
Managed	5.82	−1.30	−.49	−1.29	−1.08	1.43	1.79	4.61	4.45	2.77
Pure	5.82	−1.26	−2.97	−4.96	−6.94	Model breaks down				
M_2 (percent change):										
Baseline	8.82	8.56	9.23	10.91	10.80	10.49	9.22	10.02	9.42	10.01
Managed	8.82	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Pure	8.82	4.00	4.00	4.00	4.00	Model breaks down				
Nonborrowed reserves (percent change):										
Baseline	10.61	−2.53	1.30	10.92	14.82	13.50	7.19	7.13	6.66	7.08
Managed	10.61	−10.33	−8.22	−3.86	−.80	2.24	−1.57	1.30	5.80	.97
Pure	10.61	−11.29	−11.19	−8.46	−11.55	Model breaks down				
M_1 velocity (percent change):										
Baseline	.93	5.89	5.36	5.30	3.68	5.00	5.38	4.33	4.86	3.55
Managed	.93	9.63	9.49	11.30	9.87	6.75	4.35	.43	−.31	2.65
Pure	.93	12.84	12.70	13.36	18.00	Model breaks down				
M_2 velocity (percent change):										
Baseline	−1.85	2.64	1.47	.26	−1.23	.33	.38	.20	−.01	−.68
Managed	−1.85	4.05	4.76	5.64	4.50	4.10	2.13	1.02	.12	1.43
Pure	−1.85	7.13	5.15	3.59	5.59	Model breaks down				
Currency deposit ratio (level):										
Baseline	.388	.399	.417	.436	.456	.483	.516	.545	.579	.604
Managed	.388	.414	.460	.523	.601	.667	.712	.723	.717	.740
Pure	.388	.432	.494	.574	.733	Model breaks down				
Currency deposit ratio (percent change):										
Baseline	0	2.8	4.5	4.6	4.7	5.9	6.8	7.0	6.2	4.3
Managed	0	6.7	11.1	13.7	14.9	11.0	6.7	1.5	−.8	3.2
Pure	0	11.3	14.4	16.2	27.7	Model breaks down				

TABLE APPENDIX A.3.8.—WHARTON ANNUAL MODEL: SUDDEN DECELERATION TO 4 PERCENT ANNUAL M_2 GROWTH: STRATEGY 1 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Nominal GNP (percent change):										
Baseline	6.81	11.42	10.83	11.20	9.44	10.86	9.64	9.80	9.41	9.27
Managed	6.81	8.21	8.95	9.87	8.68	8.27	6.21	5.06	4.13	5.49
Pure	6.81	11.42	9.36	7.74	9.81		Model breaks down			
Real GNP (percent change):										
Baseline	−1.40	3.85	3.89	3.75	1.97	3.40	2.76	3.10	2.82	2.90
Managed	−1.40	.73	2.12	4.14	3.89	3.87	2.33	2.21	2.31	3.35
Pure	−1.40	3.85	2.48	.41	2.07		Model breaks down			
GNP deflator (percent change):										
Baseline	8.32	7.28	6.68	7.18	7.32	7.21	6.69	6.50	6.41	6.18
Managed	8.32	7.42	6.69	5.50	4.62	4.23	3.79	2.79	1.78	2.07
Pure	8.32	7.28	6.71	7.30	7.58		Model breaks down			
Personal consumption deflator (percent change):										
Baseline	7.49	7.04	6.89	7.13	6.96	6.71	5.81	5.90	5.47	5.51
Managed	7.50	7.11	6.81	5.73	4.54	4.21	3.27	2.35	1.26	2.75
Pure	7.50	7.04	6.96	7.38	7.17		Model breaks down			
CPI (percent change):										
Baseline	6.85	6.44	5.84	6.60	6.79	7.09	6.48	6.82	6.57	6.08
Managed	6.86	6.41	5.67	5.10	4.36	4.29	3.74	3.10	2.23	3.44
Pure	6.86	6.45	5.78	6.62	6.98		Model breaks down			
Average wage (percent change):										
Baseline	9.52	7.39	6.95	9.46	9.32	8.64	8.34	8.48	8.16	7.52
Managed	9.52	7.37	6.34	6.53	5.56	4.57	4.09	2.43	.75	1.02
Pure	9.52	7.39	7.02	9.61	9.29		Model breaks down			

TABLE APPENDIX A.3.9.—WHARTON ANNUAL MODEL: SUDDEN DECELERATION TO 4 PERCENT ANNUAL M_2 GROWTH: STRATEGY 1 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Unemployment rate:										
Baseline	9.21	8.60	7.74	7.11	7.10	6.53	6.54	6.35	6.32	6.09
Managed	9.21	10.02	10.52	10.32	9.50	8.25	8.01	7.99	7.94	7.60
Pure	9.21	8.60	8.44	9.78	10.53		Model breaks down			
3-mo T-bill yield:										
Baseline	12.67	14.00	12.04	10.79	9.59	9.44	9.21	8.80	8.58	8.23
Managed	12.67	17.21	14.01	12.32	11.09	8.84	7.71	5.41	4.52	4.35
Pure	12.67	17.22	18.15	19.64	24.11		Model breaks down			
Commercial paper rate:										
Baseline	13.74	15.19	12.86	11.50	10.21	10.05	9.79	9.36	9.12	8.74
Managed	13.74	18.66	14.98	13.16	11.83	9.39	8.18	5.69	4.74	4.54
Pure	13.74	18.67	19.45	21.06	25.90		Model breaks down			
Corporate bond rate:										
Baseline	16.02	15.86	14.51	14.23	13.59	13.08	12.65	12.12	11.91	11.67
Managed	16.02	17.45	16.06	14.44	13.00	11.83	10.01	8.08	6.97	6.88
Pure	16.02	15.86	17.45	19.96	23.32		Model breaks down			
Mortgage interest rate:										
Baseline	15.75	14.88	12.60	12.29	11.62	11.06	10.60	10.04	9.82	9.56
Managed	15.75	16.58	14.25	21.52	10.98	9.73	7.79	5.73	4.54	4.44
Pure	15.75	15.87	15.73	18.42	22.00		Model breaks down			
Government surplus or deficit:										
Baseline	−132.72	−134.61	−138.11	−101.58	−103.14	−91.31	−83.62	−75.98	−49.66	−38.14
Managed	−132.73	−177.29	−215.21	−195.22	−179.07	−166.42	−149.97	−122.88	−119.05	−110.29
Pure	−132.72	−134.61	−167.72	−204.73	−245.79		Model breaks down			

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TABLE APPENDIX A.3.10.—WHARTON ANNUAL MODEL: SUDDEN DECELERATION TO 7 PERCENT ANNUAL M_2 GROWTH: STRATEGY 3 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
M_1 (percent change):										
Baseline	5.82	5.22	5.20	5.60	5.55	5.58	4.04	5.24	4.34	5.52
Managed	5.82	2.51	2.93	2.10	2.33	2.74	2.58	3.12	3.98	3.38
Pure	5.82	2.98	1.68	−.18	−1.54	−2.39	−1.64	Model breaks down		
M_2 (percent change):										
Baseline	8.82	8.56	9.23	10.91	10.80	10.49	9.22	10.02	9.42	10.01
Managed	8.82	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Pure	8.82	7.00	7.00	7.00	7.00	7.00	7.00	Model breaks down		
Nonborrowed reserves (percent change):										
Baseline	10.61	−2.53	1.30	10.92	14.82	13.50	7.19	7.13	6.66	7.08
Managed	10.61	−5.07	−1.93	3.50	7.29	7.54	3.87	2.42	5.58	2.98
Pure	10.61	−5.55	−3.91	1.16	1.94	−1.89	−5.84	Model breaks down		
M_1 velocity (percent change):										
Baseline	.93	5.89	5.36	5.30	3.68	5.00	5.38	4.33	4.86	3.55
Managed	.93	5.91	5.30	8.67	7.22	6.83	4.51	3.88	2.03	3.61
Pure	.93	8.20	8.44	9.20	10.60	14.37	10.42	Model breaks down		
M_2 velocity (percent change):										
Baseline	−1.85	2.64	1.47	.26	−1.23	.33	.38	.20	−.01	−.68
Managed	−1.85	1.46	1.29	3.70	2.55	2.58	.19	.11	−.85	.11
Pure	−1.85	4.13	3.04	1.87	1.77	4.33	1.51	Model breaks down		
Currency deposit ratio (level):										
Baseline	.388	.399	.417	.436	.456	.483	.516	.545	.579	.604
Managed	.388	.397	.415	.455	.501	.548	.580	.610	.627	.654
Pure	.388	.409	.444	.487	.558	.675	.787	Model breaks down		
Currency deposit ratio (percent change):										
Baseline	0	2.8	4.5	4.6	4.7	5.9	6.8	5.6	6.2	4.3
Managed	0	2.3	4.5	9.6	10.1	9.4	5.8	5.2	2.8	4.3
Pure	0	5.4	8.6	9.7	14.6	21.0	16.6	Model breaks down		

TABLE APPENDIX A.3.11.—WHARTON ANNUAL MODEL: SUDDEN DECELERATION TO 7 PERCENT ANNUAL M_3 GROWTH: STRATEGY 3 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Nominal GNP (percent change):										
Baseline	6.81	11.42	10.83	11.20	9.44	10.86	9.64	9.80	9.41	9.27
Managed	6.80	8.57	8.38	10.96	9.73	9.76	7.21	7.12	6.09	7.12
Pure	6.80	11.42	10.26	9.01	8.90	11.64	8.61	Model breaks down		
Real GNP (percent change):										
Baseline	−1.40	3.85	3.89	3.75	1.97	3.40	2.76	3.10	2.82	2.91
Managed	−1.40	1.22	1.70	4.68	4.51	4.82	2.48	2.88	2.47	3.22
Pure	−1.40	3.85	3.34	1.66	1.28	4.12	1.98	Model breaks down		
GNP deflator (percent change):										
Baseline	8.32	7.28	6.68	7.18	7.32	7.21	6.69	6.50	6.41	6.18
Managed	8.32	7.26	6.57	6.00	4.99	4.71	4.62	4.12	3.54	3.78
Pure	8.32	7.28	6.69	7.23	7.53	7.22	6.50	Model breaks down		
Personal consumption deflator (percent change):										
Baseline	7.49	7.04	6.89	7.13	6.96	6.71	5.81	5.90	5.47	5.51
Managed	7.50	6.97	6.75	6.12	4.97	4.50	3.88	3.43	2.69	4.01
Pure	7.50	7.04	6.92	7.26	7.16	6.64	5.72	Model breaks down		
CPI (percent change):										
Baseline	6.85	6.44	5.84	6.60	6.79	7.09	6.48	6.82	6.57	6.08
Managed	6.86	6.31	5.60	5.58	4.73	4.78	4.40	4.29	3.74	4.83
Pure	6.86	6.45	5.81	6.60	6.94	7.03	6.29	Model breaks down		
Average wage (percent change):										
Baseline	9.52	7.39	6.95	9.46	9.32	8.64	8.34	8.48	8.16	7.52
Managed	9.52	7.17	6.18	7.16	6.26	5.62	5.49	4.71	3.50	3.69
Pure	9.52	7.39	6.97	9.54	9.36	8.48	8.34	Model breaks down		

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TABLE APPENDIX A.3.12.—WHARTON ANNUAL MODEL: SUDDEN DECELERATION TO 7 PERCENT ANNUAL M_3 GROWTH: STRATEGY 3 RESULTS

[Baseline results derived under March 1982 assumptions]

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Unemployment rate:										
Baseline	9.21	8.60	7.74	7.11	7.10	6.53	6.54	6.35	6.32	6.09
Managed	9.21	9.76	10.34	9.86	8.73	6.94	6.44	6.01	5.84	5.52
Pure	9.21	8.60	8.01	8.55	9.36	8.77	9.09	Model breaks down		
3-mo T-bill yield:										
Baseline	12.67	14.00	12.04	10.79	9.59	9.44	9.21	8.80	8.58	8.23
Managed	12.67	15.74	12.74	11.04	9.69	9.39	8.84	8.20	7.04	7.04
Pure	12.67	15.07	14.31	14.32	15.50	18.53	19.19	Model breaks down		
Commercial paper rate:										
Baseline	13.74	15.19	12.86	11.50	10.21	10.05	9.79	9.36	9.12	8.74
Managed	13.74	17.07	13.61	11.77	10.31	9.99	9.40	8.71	7.45	7.45
Pure	13.74	16.35	15.31	15.31	16.59	19.87	20.57	Model breaks down		
Corporate bond rate:										
Baseline	16.02	15.86	14.51	14.23	13.59	13.08	12.65	12.12	11.91	11.67
Managed	16.02	17.31	15.35	14.78	13.33	12.42	11.54	10.67	9.90	9.20
Pure	16.02	15.86	15.55	16.39	17.42	19.25	21.13	Model breaks down		
Mortgage interest rate:										
Baseline	15.75	14.88	12.60	12.29	11.62	11.06	10.60	10.04	9.82	9.56
Managed	15.75	16.43	13.49	12.89	11.34	10.36	9.42	8.50	7.67	6.92
Pure	15.75	15.21	13.71	14.60	15.70	17.66	19.67	Model breaks down		
Government surplus or deficit:										
Baseline	−132.72	−134.61	−138.11	−101.58	−103.14	−91.31	−93.62	−75.98	−49.66	−38.14
Managed	−132.73	−172.22	−213.65	−182.04	−157.32	−127.76	−115.28	−93.05	−81.57	−75.24
Pure	−132.72	−134.61	−149.21	−153.38	−182.41	−183.51	−230.11	Model breaks down		

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I. THE NOMINAL GNP AND VELOCITY RESULTS

ARITHMETIC RELATIONSHIPS

Our point of departure for discussing the results of the model simulations of the four money growth strategies is the familiar GNP variant of the equation of exchange. In this equation, it is a matter of arithmetic that in a particular year or other time period, the percentage change in nominal Gross National Product (GNP) equals the percentage change in the money supply (however denfied), plus the percentage change is the definition of money's velocity in the same time period. This is a truism; a matter of arithmetic, not economics.[1] The statement is true because whatever measure of money is used, its velocity or turnover into GNP goods and services in a given time period is defined by the ratio of nominal GNP in the same period to the average quantity of the money in question that was held by the public in that period.

Thus, for example, in 1980, nominal GNP was $2,633.1 billion and M_1 or transactions money[2] averaged $401.3 billion. By definition, then, M_1 velocity averaged: ($2,633.1/$401.3) or 6.561 in 1980. In 1981 nominal GNP was $2,937.7 billion, M_1 averaged $429.6 billion and M_1's velocity averaged 6.838. It follows as a matter of arithmetic that, in 1981, nominal GNP grew 11.57 percent, M_1 increased 7.05 percent and M_1 velocity rose by 4.22 percent.[3]

EFFECTS OF CHANGES IN MONEY GROWTH ON NOMINAL GNP GROWTH AND THE RATE OF RISE OF VELOCITY IN TRADITIONAL ECONOMIC THEORY, AND SOME EVIDENCE

Traditional economic theory suggests that after the public has had enough time to adjust to changes in M_1 growth, such changes will be registered percentage point for percentage point in nominal GNP growth with no effect whatever on the rate of rise of velocity.[4] Post-Korean War-United States history bears this out. To begin with, although ex post neither the stock of M_1 money demanded relative to nominal GNP, i.e., the level of M_1 velocity, nor the rate of rise of M_1

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[1] However, a caveat is in order. The statement is true only for very small changes. For larger changes, it is only approximately true. The exact formula for larger changes is: the percentage change in nominal GNP equals ((1+(percentage change in money/100)) times (1+(percentage change in velocity/100)−1) times 100.

[2] M_1 is measured by the sum of publicly held coin, currency, non-bank traveller's checks and deposits in depository institutions that are subject to check.

[3] Where, 11.57=((2.937.7−2.633.1)/2.633.1) times 100. 7.05=((429.6−401.3)/401.3) times 100, and 4.22=((6.838−6.561)/6.838)) times 100. In turn, ((1+.0705) times (1+.0422)−1)×100=11.57. Data used are the latest available revisions in July 1982.

[4] This assumes that the changes in M_1 growth are not large and autocorrelated. In the event they were, the rate of rise of velocity is likely to rise and fall together with increases and decreases in money growth, and hence nominal GNP growth would rise and fall more percentagewise than M_1 growth. However, in the United States in the post-Korean War period, at least through 1981, changes in M_1 growth were not large enough or sufficiently autocorrelated to cause the rate of rise of velocity to move in the same direction, as the data discussed next show.

velocity is a constant, the rate of rise of M_1 velocity has changed relatively little from year to year, and still less from triennium to triennium. Table I.1 sets forth year-to-year percentage changes in nominal GNP, M_1, and M_1 velocity in the 1956 to 1981 period. Table I.2 sets forth average yearly changes from one triennium to the next. The data show that measured from one year to the next the rate of rise of M_1 velocity ranged between 0.04 and 6.27 percent in the 1956 to 1981 period, versus 0.04 to 8.21 percent for M_1 and 1.27 to 12.41 percent for nominal GNP. From one triennium to the next, the average yearly rate of rise of M_1 velocity ranged between 1.81 and 3.85 percent, compared to 0.97 to 7.85 percent for M_1 growth and 3.99 to 12.00 percent for nominal GNP growth.

TABLE I.1.—GROSS NATIONAL PRODUCT, MONEY SUPPLY, AND VELOCITY MEASURES

[Year-to-year percent changes, 1956-81][1]

Year	Nominal GNP	M_1	M_1 velocity
1956	5.41	1.19	4.17
1957	5.28	.53	4.73
1958	1.27	1.21	.04
1959	8.52	2.13	6.27
1960	3.82	.04	3.78
1961	3.56	2.05	1.46
1962	7.72	2.48	5.13
1963	5.61	3.04	2.49
1964	6.87	3.90	2.86
1965	8.36	4.26	3.92
1966	9.39	4.57	4.62
1967	5.77	3.97	1.73
1968	9.23	7.01	2.07
1969	8.09	5.94	2.04
1970	5.17	3.80	1.33
1971	8.53	6.77	1.65
1972	10.05	7.17	2.67
1973	11.85	7.28	4.25
1974	8.13	5.00	2.99
1975	8.01	4.66	3.19
1976	10.90	5.68	4.96
1977	11.64	7.64	3.71
1978	12.41	8.21	3.86
1979	11.96	7.70	3.99
1980	8.79	6.27	2.38
1981	11.41	7.03	4.09
Using shift adjusted M_1: 1981	11.41	4.62	6.49

[1] Based on data available in June 1982. There have been revisions in the GNP and M_1 (and hence the M_1 velocity data) for latter years since then. For example, in 1981, nominal GNP increased 11.57 percent, M_1 grew 7.05 percent and M_1 velocity increased 4.22 percent. Because our regressions, reported below, had been run before the July revisions became available, we decided not to revise the tables so that our results could be replicated if desired. Rerunning the regressions with the revised data would have been a bit of a problem. Because the revisions were relatively minor, we decided against it.

TABLE I.2.—YEARLY AVERAGE PERCENT CHANGES IN GNP, M_1 AND M_1 VELOCITY

[3-yr nonoverlapping periods, 1956 to 1981][1]

	Nominal GNP	M_1	M_1 velocity
3-yr period:			
1956-58	3.99	0.97	2.98
1959-61	5.30	1.41	3.84
1962-64	6.73	3.14	3.49
1965-67	7.84	4.27	3.42
1968-70	7.50	5.58	1.81
1971-73	10.14	7.08	2.86
1974-76	9.01	5.11	3.71
1977-79	12.00	7.85	3.85
1980-81	10.10	6.65	3.23

[1] Based on data available in June 1982. See the footnote to table I.1. Yearly average percent changes are averages of the year-to-year percent changes in triennial periods.

Closer inspection of the data in Tables I.1 and I.2 indicates that the changes in the rate of rise of M_1 velocity that occurred in the 1956 to 1981 period were not linked to changes in M_1 growth, while the changes in nominal GNP growth were. When M_1 growth was increased and decreased, nominal GNP growth rose and fell in association, and very nearly percentage point for percentage point. But the rate of rise of velocity was little changed and definitely did not move in tandem with M_1 growth.

Regressions that use the data in Tables I.1 and I.2 confirm these conclusions. Using year-to-year data, the coefficient of M_1 growth in the regression of the rate of rise of M_1 velocity on M_1 growth is −.016. It is not significantly different from zero (see equation number 1, below). Using yearly average percent changes in the triennial periods, the coefficient is −.032 and again is not significantly different from zero (see equation number 2, below).

In contrast, the relationship of nominal GNP growth to M_1 growth is one-to-one and it is statistically significant. Using year-to-year data, the pertinent regression equation (number 3, below) predicts yearly nominal GNP growth equal to 3.31 percent plus 1.02 times the percentage growth in M_1 in the same year, where the constant term (3.31 percent) is the regression estimate of the average yearly trend percentage increase in M_1 velocity. Using triennial data, the regression of nominal GNP growth on M_1 growth (number 4, below) predicts yearly nominal GNP growth equal to 3.39 percent plus exactly 1.00 times M_1 percentage growth in the same triennium. Complete regression results are set forth below. Numbers in parentheses are T statistics.

1. Using year-on-year data, 1956 to 1981:
    Yearly M_1 velocity percentage increase=
    3.32−.016 times (yearly percentage M_1 growth)
    (5.38) (−0.13)
    Adjusted R^2=−.04
    Standard error=1.46
    Durbin-Watson=2.39
2. Using triennial data, 1956 to 1981:
    Yearly M_1 velocity percentage increase=
    3.39−.032 times (yearly percentage M_1 growth)
    (6.60) (−.324)
    Adjusted R^2=−.13
    Standard error=.68
    Durbin-Watson=1.80
3. Using year-on-year data, 1956, to 1981;
    Yearly nominal GNP growth=
    3.31+1.02 times (yearly percentage M_1 growth)
    (5.22) (8.32)
    Adjusted R^2=.73
    Standard error=1.50
    Durbin-Watson=2.35
4. Using triennial data, 1956 to 1981:
    Yearly nominal GNP growth=
    3.39+1.00 times (yearly percentage M_1 growth)
    (6.27) (9.65)
    Adjusted R^2=.92
    Standard error=.71
    Durbin-Watson=1.79

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In summary, the data show that, in the 1956 to 1981 period, from year to year and triennium to triennium, the rate of rise of M_1 velocity was not related to M_1 growth, while nominal GNP growth was closely related to M_1 growth, tending to rise percentage point for percentage point with M_1 growth, both triennium to triennium and year to year. The evidence from the post-Korean War period thus confirms that, after the public has had a year or more to adjust to changes in M_1 growth, nominal GNP growth will change percentage point for percentage point and there is no effect on the rate of rise of M_1 velocity whatsoever.[5]

SIMULATION RESULTS

The Chase, DRI, and Wharton simulations for the 1982 to 1991 period generate very different relationships between nominal GNP growth and money growth and between the latter and the rate of rise of its velocity than those that traditional economic theory suggests and history affirms.

Selected predictions of yearly nominal GNP growth and yearly rates of rise of velocity are set forth in Tables I.3 and I.4. The former give the pure simulation results, the latter give the managed simulation results. The most striking common result is that the rate of rise of velocity moves inversely across money growth scenarios. The extent of the move depends on the model used and whether it is managed or not. But in all cases, the rate of rise of velocity moves inversely across money growth scenarios, and the extent of the move is always substantial in the pure simulations. Fast money growth is associated with relatively small yearly velocity growth; slow and zero money growth are associated with relatively rapid velocity growth. Nominal GNP growth is thus relatively little changed by money growth in the pure simulations.[6]

TABLE I.3.—PURE SIMULATION RESULTS

[Yearly percentage changes in M_1, M_1 velocity, and nominal GNP]

Model and strategy	Period	Average yearly results: M_1	Average yearly results: M_1 velocity	Average yearly results: Nominal GNP	Final year results: M_1 velocity	Final year results: Nominal GNP
Chase:						
2	1986-90	−0.1	8.6	8.5	7.3	7.6
4	1986-90	10.0	.4	10.4	−.1	10.0
1	1983-88	.1	9.5	9.5	8.1	8.4
3	1983-88	3.0	7.0	10.0	5.8	8.9
DRI:						
2	1987-91	0	10.9	10.9	11.0	11.0
4	1987-91	10.0	3.9	14.2	2.0	12.2
1	1984-87	0	13.5	13.5	15.9	16.0
3	1984-87	3.0	7.8	11.0	6.5	9.8
Wharton:[1]						
2	1987	4.0	6.9	11.2	6.9	11.2
4	1987	14.0	−1.4	12.4	−1.4	12.4
1	1983-86	4.0	5.4	9.6	5.6	9.8
3	1983-86	7.0	2.7	9.9	1.8	8.9

[1] M_2 growth was used in Wharton's simulations and the velocity results are for M_2 velocity growth.

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[5] In the case of M_2, the evidence is the same for most of the 1956 to 1981 period. Nominal GNP increased percentage point for percentage point with M_2 growth. Velocity growth, which averaged zero, was unaffected. In recent years, M_2 velocity growth has been positive and nominal GNP has grown faster than M_2 has increased. We point this out because Wharton, recall, targeted M_2 growth.

[6] We recognize that in comparing simulation results across money growth scenarios to historical experience, we are comparing cross-section data to time-series data (history).

PURE SIMULATION RESULTS

Table I.3 gives the velocity rate of rise and nominal GNP growth results of the pure simulations for relevant time periods. We analyze the results by pairing the gradual deceleration to zero M_1 growth and gradual acceleration to 10 percent per year M_1 growth strategies (numbers 2 and 4) and the sudden deceleration to zero and 3 percent per year strategies (numbers 1 and 3). We define the relevant time periods as years when simulated money growth is close to the equilibrium strategy or scenario money growth for *both* members of the paired strategies. We could have defined a relevant period for each money-growth strategy separately but saw no advantage in doing that, and moreover a cursory inspection of the simulation results indicated that this grouping of the results would not have affected our conclusions.

In the cases of scenarios 1 and 3, simulated money growth reaches the scenario equilibrium rate in 1983 and remains there until the end of the simulation period (1991), or until the model breaks down. Under scenarios 2 and 4, M_1 growth is programmed to reach the equilibrium rate only gradually. Hence, the relevant periods start later for this pair—after 1983.

In the pure simulations of the Chase model, between four-fifths and five-sixths of incremental money growth is absorbed by a fall in the rate of rise of M_1 velocity. Only one-sixth to one-fifth is registered in faster nominal GNP growth. In the 1983 to 1988 period (here we are comparing the reults for scenarios numbers 1 and 3), the rate of rise of M_1 velocity is 2.5 percent a year lower with 3.0 percent per year M_1 growth than it is with 0.1 percent per year M_1 growth. As a corollary, 3.0 percent per year M_1 growth is associated with only one-half percent per year higher nominal GNP growth than 0.1 percent a year M_1 growth.

Comparing the Chase pure simulation results for scenarios numbers 2 and 4 (relevant time period is 1986 to 1990), 10 percent per year money growth is associated with only 1.9 percent per year faster nominal GNP growth than is −0.1 percent per year M_1 growth. The bulk of the difference in money growth, 8.2 percentage points, is absorbed by the rate of rise of M_1 velocity which averaged a phenomenal but unbelievable 8.6 percent per year with −0.1 percent per year M_1 growth but only 0.4 percent per year with 10 percent per year M_1 growth, which is equally unbelievable.

In the pure simulations of the DRI model, 10 percent per year money growth results in only 3.3 percent per year higher nominal GNP growth than zero M_1 growth in the 1987 to 1991 period. The rate of rise of velocity is 7 percent a year lower. DRI's pure simulations of the sudden deceleration of M_1 growth to zero (strategy number 1) and 3 percent a year (number 3) produce even more far-fetched results.

The former will tend to reveal more about long-run relationships and the latter more about the short run. Thus, a problem of comparability exists. However, because money growth varies very little from year to year in each scenario, regression analyses of the time-series data that are generated by simulating each money growth scenario separately would not prove fruitful or useful. Moreover, our historical time-series analyses are organizd to bring out long-run relationships. The historical time-series data are analyzed from one full year to the next and one triennium to the next. Finally, insofar as our comparisons are biased, the bias is in the direction of showing the simulation results to better advantage.

Both nominal GNP growth and the rate of rise of velocity are higher under the zero money growth strategy.

The pure simulations of the Wharton model produce similar and similarly far-fetched results. The Wharton model is not designed to target M_1 growth. Instead of our experimental M_1 growth scenarios, Wharton's managers chose yearly M_2 growth rates of 4 percent, 7 percent, and 14 percent to roughly correspond to yearly M_1 growth rates of zero, 3 percent and 10 percent. In specific, instead of strategies 1 and 2, the Wharton model was simulated for 4.0 percent a year M_2 growth reached suddenly and gradually, respectively. Instead of strategies 3 and 4, it used 7.0 percent a year M_2 growth reached suddenly and 14.0 percent a year reached gradually.

Comparing the results for Wharton strategies 2 and 4 for 1987, which is the only year that simulated M_2 growth coincides with the equilibrium strategy M_2 growth rates (4.0 and 14.0 percent a year), nominal GNP is only 1.2 percentage points higher for 14.0 percent than for 4.0 percent M_2 growth and the rate of rise of M_2 velocity in 1987 is (accordingly) a mammoth 8.3 percent higher for 4.0 percent M_2 growth than for 14.0 percent M_2 growth. Comparing strategies 1 and 3, in the 1983 to 1986 period, 7.0 percent yearly M_2 growth, which is the equilibrium for strategy 3, is associated with nominal GNP growth that averages only 0.3 percent a year higher than it does under 4.0 percent per year M_2 growth (the equilibrium rate of strategy number 1). The rate of rise of M_2 velocity averages 2.7 percent a year higher with 4.0 percent a year M_2 growth than with 7.0 percent per year M_2 growth.

TABLE I.4.—MANAGED SIMULATION RESULTS

[Yearly percentage changes in M_1, M_1 velocity, and nominal GNP]

Model and strategy	Period	Average yearly results			Final year results	
		M_1	M_1 velocity	Nominal GNP	M_1 velocity	Nominal GNP
Chase:						
2	1986-90	−0.1	8.6	8.3	7.3	6.8
4	1986-90	10.5	1.2	11.6	.5	11.2
1	1983-88	0	8.6	8.6	8.0	8.2
3	1983-88	2.9	6.7	9.5	5.9	8.9
DRI:						
2	1986-91	0	7.7	7.7	6.4	6.4
4	1986-91	10.0	3.2	13.5	2.1	12.3
1	1983-91	0	8.2	8.2	6.2	6.2
3	1983-91	3.0	6.6	9.8	5.1	8.2
Wharton:[1]						
2	1987-91	4.0	2.3	6.4	1.4	5.4
4	1987-91	14.0	−1.3	12.5	−.9	13.0
1	1983-91	4.0	3.1	7.2	1.4	5.5
3	1983-91	7.0	1.2	8.3	0	7.1

[1] M_2 growth was used in Wharton's simulations and the velocity results are for M_2 velocity growth.

MANAGED SIMULATION RESULTS

The managed simulations produce nominal GNP growth and velocity growth results that are more credible than the corresponding pure simulation results. However, the managed nominal GNP growth and velocity rate of rise results are far from what U.S. experience in the post-Korean War period shows happens to nominal GNP and velocity under different money growth scenarios. Table I.4 presents relevant nominal GNP growth and velocity growth results of the managed simulations.

In the managed simulations of the Chase model, in the 1986 to 1990 period, which is the equilibrium period for strategies 2 and 4, 10.5 percent per year M_1 growth is associated with nominal GNP growth that averages only 3.3 percent a year higher than it does with −0.1 percent a year M_1 growth. The yearly rate of rise of velocity averages 7.4 percent lower with 10.5 percent a year M_1 growth than it does with 0.1 percent a year M_1 growth. In the 1983 to 1988 period—the relevant one for strategies 1 and 3—2.9 percent a year M_1 growth results in only 0.9 percent higher yearly nominal GNP growth than zero M_1 growth, but 1.9 percent a year slower velocity growth.

The DRI and Wharton managed results are closer to the marks of recent U.S. experience, but still are quite far away. In the managed simulations of the DRI model, in the 1983 to 1991 period, 3.0 yearly M_1 growth results in only 1.6 percent a year higher nominal GNP growth than zero M_1 growth produces. A lower rate of rise in M_1 velocity absorbs the other half of the higher money growth. In the 1986 to 1991 period, 10.0 percent M_1 growth is associated with nearly 6.0 percent a year higher nominal GNP growth and a 4.5 percent per year lower yearly increase in velocity than zero M_1 growth.

In the managed simulations of the Wharton model, 7.0 percent a year M_2 growth results in only 1.1 percent a year higher nominal GNP growth than 4.0 percent a year M_2 growth in the 1983 to 1991 period, which is the relevant one for strategies 1 and 3. The average yearly rate of rise of M_2 velocity is 1.9 percent a year lower in the higher M_2 growth scenario. However, 14.0 percent M_2 growth is associated with 6.1 percent a year faster nominal GNP growth and 3.6 percent a year slower velocity growth than 4.0 percent a year M_2 growth in the 1987 to 1991 period, which is the relevant period for strategies 2 and 4.

SUMMARY

In summary, the nominal GNP and velocity results of the *pure* simulations are not believable. They are contrary to traditional economic theory and, more important, to U.S. long-run experience in the post-Korean War period. We can only speculate on the reason or reasons why. Our belief is that the reason is that the models that were used to simulate the selected money growth strategies were built to essentially short-run specifications. The Chase model that was used to simulate our money growth scenarios is a quarterly model. It was built to track and forecast the economy from quarter to quarter. The DRI and Wharton models that were used are annual models but appear to have been derived from the DRI and Wharton quarterly models. Such models are unlikely to generate economically sensible and empirically valid *long-run* results.

The reason models built to short-run specifications are unlikely to produce sensible and valid long-run results is that the long-run effects of changes in policy variables often are different from and even opposite of the short-run effects. Models built to short-run specifications are likely to generate only the initial effects of the policy changes. Because the impact of changes in money growth on aggregate spending (demand) are distributed in time, in the short run, increased money growth is likely to be partly offset by an opposite change in the rate of rise of velocity and nominal GNP growth will rise less than percentage point for percentage point. However, in the long run, nominal GNP is likely to change in the same direction and in proportion to the change in money growth and the rate of rise of velocity is likely to be unaffected, as shown by the data in Tables I.1 and I.2 and by the regression analyses of these data.

In the managed simulations, the adjustments made by the managers captured the long-run feedback effects on nominal GNP growth and the rate of rise of velocity in part, but far from fully. For Chase, only one-third of higher money growth registers in higher nominal GNP growth; two-thirds is absorbed by lower velocity growth. For DRI and Wharton, about three-fifths of higher money growth registers in higher nominal GNP growth and two-fifths is absorbed by lower velocity growth, at the end of the simulation period, for Wharton, only one-fifth is absorbed by lower velocity growth.

II. THE REAL GROWTH AND UNEMPLOYMENT RESULTS

Real GNP Growth

A basic tenet of modern monetary economics is that the growth of the Nation's real GNP cannot be permanently changed by changing the growth rate of its money supply. As discussed, it takes a little time for aggregate demand to rise (substantially) following increases in money growth. After that initial period, real GNP growth is likely to increase for a time. It is especially likely to increase if the economy has been receding. However, in time, increases in money growth tend to be fully dissipated in higher inflation. Thus, the growth of real GNP cannot be permanently or even long increased by increasing money growth. Vice versa, decreases in money growth tend to decrease real GNP growth in the short run, often resulting in or exacerbating business recessions, but in time the inflation rate falls in proportion to the decrease in money growth, and real GNP growth returns to the normal long-run rate. That is the essence of modern monetary theory.

Consistent with the above hypothesis, faster money growth has not produced permanently higher real GNP growth in the United States in the post-Korean War period. In fact, relatively fast money growth in the second half of this period was actually associated with lower GNP growth. From 1956 to 1967 when M_1 growth averaged only 2.4 percent per year real GNP growth averaged 3.7 percent, compared to 2.9 percent in the 1968 to 1981 period when M_1 growth averaged 6.4 percent per year. Regression analysis confirms that increasing money growth did not produce higher U.S. real GNP growth—at least for very long—during the post-Korean War years.

1. Using year-to-year data, 1956 to 1981:
   Yearly real GNP growth=
   2.17 + 0.24 (yearly percentage M_1 growth)
   (2.21) (1.27)
   Adjusted $R^2=.02$
   Standard Error=2.32
   Durbin-Watson=1.49
2. Using triennial data:
   Yearly real GNP growth=
   2.71 + 0.10 (yearly percentage M_1 growth)
   (1.92) (0.28) (yearly percentage M_1 growth)
   Adjusted $R^2=0.12$
   Standard Error=1.86
   Durbin-Watson=2.43

Simulation Real GNP Results

By and large, the pure simulation results deny and the managed simulation results confirm the neutrality of money growth with respect to real GNP growth in the long run.

In the pure simulations, for all three models, gradual acceleration to high money growth results in real GNP growth rates that are higher than both baseline real GNP growth rates and real GNP growth rates projected under lower money growth scenarios for nearly the entire simulation period. Relevant data are given in Tables II.1a, II.1b and II.1c, and II.2 and II.3.

TABLE II.1a.—BASELINE AND SIMULATION REAL GNP GROWTH RESULTS—CHASE

Year	Baseline results	Pure simulation results for strategies [1]				Managed simulation results for strategies			
		2	4	1	3	2	4	1	3
1983	3.99	3.89	4.03	3.67	3.83	2.81	4.80	1.64	2.57
1984	3.90	3.74	3.97	3.59	3.75	2.54	4.17	2.30	2.90
1985	3.33	3.26	3.40	3.37	3.34	2.96	4.30	3.47	3.61
1986	3.41	3.28	3.54	3.36	3.34	2.76	3.73	3.20	3.05
1987	3.22	3.02	3.41	3.15	3.10	3.11	4.18	3.54	3.77
1988	3.05	2.80	3.27	2.92	2.91	3.06	3.46	3.10	3.23
1989	3.01	2.72	3.26	3.19	2.86	3.21	3.21	3.02	2.84
1990	2.85	2.52	3.12	2.97	2.70	2.95	3.13	2.94	2.52
1991	2.75	2.80	3.02	2.99	2.63	2.71	3.16	2.80	2.28

[1] No. 2 calls for reducing M_1 growth to zero gradually; No. 4 calls for accelerating it to 10 percent a year gradually; No. 1 calls for reducing it to zero suddenly and No. 4 calls for reducing it to 3 percent a year suddenly.

TABLE II.1b.—BASELINE AND SIMULATION REAL GNP GROWTH RESULTS—DRI

Year	Baseline results	Pure simulation results for strategies				Managed simulation results for strategies			
		2	4	1	3	2	4	1	3
1983	3.6	3.0	4.6	2.0	2.9	3.1	4.3	2.6	3.2
1984	4.0	3.4	5.7	2.5	4.0	2.6	4.9	2.9	3.8
1985	4.0	2.3	5.6	5.1	3.5	3.4	3.4	4.9	3.9
1986	3.5	3.5	6.0	7.0	4.2	4.0	2.7	4.5	4.2
1987	3.0	2.6	4.3	5.9	3.1	3.5	2.4	3.3	3.2
1988	3.4	4.4	4.1	([1])	3.5	3.6	3.2	3.5	3.0
1989	3.1	4.4	3.3	([1])	3.2	3.6	3.5	3.3	3.4
1990	2.5	3.4	2.2	([1])	2.4	2.8	2.7	2.6	2.4
1991	2.7	3.1	2.5	([1])	2.8	2.7	2.2	2.5	2.3

[1] Model breaks down.

TABLE II.1c.—BASELINE AND SIMULATION REAL GNP GROWTH RESULTS—WHARTON

Year	Baseline results	Pure simulation results for strategies [1]				Managed simulation results for strategies			
		2	4	1	3	2	4	1	3
1983	3.85	3.85	3.85	3.85	3.85	2.15	4.39	0.73	1.22
1984	3.89	3.49	4.81	2.48	3.34	2.34	3.36	2.12	1.70
1985	3.75	1.72	4.54	.41	1.66	3.55	3.03	4.14	4.68
1986	1.97	.74	3.15	2.07	1.28	3.11	1.80	3.89	4.51
1987	3.40	3.61	4.92	([1])	4.12	3.68	3.07	3.87	4.82
1988	2.76	1.98	([1])	([1])	1.98	2.00	2.74	2.33	2.48
1989	3.10	([1])	([1])	([1])	([1])	3.00	2.00	2.21	2.88
1990	2.82	([1])	([1])	([1])	([1])	2.70	2.19	2.31	2.47
1991	2.91	([1])	([1])	([1])	([1])	3.02	2.45	3.35	3.22

[1] Model breaks down.

As in the case of the nominal GNP and velocity results, these reresults would appear to reflect the short-run orientation or roots of the models. Because increased money growth is likely to increase real GNP growth in the short run, models oriented or rooted in short-run economics are likely to reflect this bias in long-run simulations, unless a feedback that returns real GNP growth to the normal long-run rate is built into them.

In the managed simulations, DRI and Wharton correct the bias. As highlighted by the summary statistics in Tables II.2 and II.3 in the managed simulations, there is very little difference in real GNP growth rates projected by DRI for zero M_1 growth, 3 percent M_1 growth per year, and 10 percent M_1 growth per year, and by Wharton for 4 percent a year, 7 percent a year and 14 percent a year M_2 growth. However, the bias persists in Chase's managed simulations. Results of the simulations of the Chase model show a small bias towards higher real GNP growth in association with high money growth.

TABLE II.2.—PURE SIMULATION RESULTS

[Yearly percentage changes in M_1 and real or constant GNP and unemployment rate levels]

Model and strategy	Period	Average yearly results			Final year results	
		M_1	Real GNP	Unemployment	Real GNP	Unemployment
Chase:						
2	1986-90	−0.1	2.87	7.95	2.52	9.54
4	1986-90	10.0	3.32	5.05	3.12	4.31
1	1983-88	.1	3.34	8.52	2.92	9.43
3	1983-88	3.0	3.38	7.36	2.91	6.81
DRI:						
2	1987-91	0	3.58	6.58	3.10	5.30
4	1987-91	10.0	3.28	4.22	2.50	4.80
1	1984-87	0	5.13	7.58	5.90	5.20
3	1984-87	3.0	3.66	7.72	3.50	6.70
Wharton:[1]						
2	1987	4.0	3.61	9.23	3.61	9.23
4	1987	14.0	4.92	3.05	4.92	3.05
1	1983-86	4.0	2.20	9.33	2.07	10.53
3	1983-86	7.0	2.53	8.63	1.28	9.36

[1] M_2 growth was used in Wharton's simulations.

TABLE II.3.—MANAGED SIMULATION RESULTS

[Yearly percentage changes in M_1 and real or constant dollar GNP and unemployment rate levels]

Model and strategy	Period	Average yearly results			Final year results	
		M_1	Real GNP	Unemployment	Real GNP	Unemployment
Chase:						
2	1986-90	−0.1	3.02	9.17	2.95	9.60
4	1986-90	10.0	3.54	3.42	3.13	2.66
1	1983-88	.1	2.88	10.51	3.10	10.62
3	1983-88	3.0	3.19	8.73	3.23	8.01
DRI:						
2	1986-91	0	3.36	7.03	2.70	6.40
4	1986-91	10.0	2.78	6.73	2.20	6.60
1	1983-91	0	3.34	7.92	2.50	6.50
3	1983-91	3.0	3.27	7.23	2.30	6.30
Wharton:[1]						
2	1987-91	4.0	2.88	7.91	3.02	7.58
4	1987-91	14.0	2.49	8.28	2.45	9.09
1	1983-91	4.0	2.78	8.93	3.35	7.60
3	1983-91	7.0	3.11	7.72	3.22	5.52

[1] M_2 growth was used in Wharton's simulations.

By and large, the managed simulations also produce appropriate time patterns of real GNP growth. For example, in all three managed simulations, real GNP growth is high initially then falls back, when M_1 growth is accelerated to 10 percent per year (14 percent for M_2 in Wharton's simulation of this strategy). And it initially falls but then rises in the managed simulations of the gradual deceleration to zero M_1 growth strategy (4 percent for M_2 in the Wharton simulation).

On the whole, then, the real GNP growth managed results are reasonable. Most importantly, consistent with traditional economic theory and U.S. experience, money growth does not substantially or permanently affect real GNP growth.

UNEMPLOYMENT

The unemployment results usually are not believable, especially in the pure simulations. In specific, as shown by the summary statistics in Table II.2, the pure simulations of the gradual acceleration to high money growth strategy (strategy number 4) result in much lower unemployment than would appear likely in view of the companion real GNP growth results.

For example, in the pure simulations of the DRI model, unemployment averages 2.36 percentage points lower when M_1 growth averages 10 percent a year (strategy 4) than when it averages zero (strategy 2), even though average yearly real GNP growth is actually lower under the high M_1 growth strategy.

In the pure simulations of the Chase model, unemployment averages 2.9 percentage points lower in the simulation of strategy 4 than in the simulation of strategy 2, even though real GNP growth is less than one-half percent lower in the zero M_1 growth scenario (strategy 2) than in the high money growth scenario (strategy 4).

In the pure simulations of the Wharton model, unemployment averages 6.18 percent higher when M_2 growth is 4 percent than when it is 14 percent, even though average yearly real GNP growth is only 1.3 percent lower.

The results of the managed simulations of the DRI and Wharton models are more believable. In the managed simulations of these models, unemployment differs by no more than 1.21 percentage points across the four money growth strategies, and real GNP growth is virtually the same. However, it is puzzling that DRI's results show higher average unemployment for the low money growth scenario even though the low money growth scenarios produce somewhat higher real GNP growth.

But the managed simulations of the Chase model produce unemployment results that are even more unbelievable than that model's pure simulation results. For example, in the 1986 to 1990 period, unemployment averages 9.17 percent when yearly M_1 growth is -0.1 percent versus 3.42 percent when yearly M_1 growth averages 10.0 percent, even though real GNP growth is nearly the same in the two scenarios—3.02 percent yearly in the zero M_1 growth scenario versus 3.54 percent in the 10 percent per year M_1 growth scenario.

In summary, all three models appear to have badly misspecified the real GNP growth-unemployment relationship. DRI and Wharton correct for this, at least to some extent, in the managed simulations. Chase does not. We find the unemployment results of the pure simulations of all three models and the Chase managed simulations to be puzzling and extremely disturbing. The real GNP growth-unemployment relationship is basic. It is a foundation of macroeconomics, witness for example Okun's Law. Models that fail to show this relationship in their simulations would appear to be in dramatic need of rework. And, results obtained in simulating them should not be trusted in seeking guidance in making public policy.

III. INFLATION AND INTEREST RATES

INFLATION

Modern monetary theory hypothesizes that over a period of years, the rate of inflation will closely track the rate of growth of the money supply. Events in the United States in the post-Korean War period support this hypothesis. Yearly inflation, measured by the year-on-year rate of rise of the GNP deflator, averaged 2.2 percent and M_1 growth 2.4 percent from 1956 to 1967, while inflation averaged 6.6 percent and M_1 growth 6.4 percent from 1968 to 1981. From one triennium to the next, during this period the rate of GNP inflation tracked M_1 growth lagged two years very closely. The year-to-year relationship between the GNP inflation rate and lagged M_1 growth was almost as close, and in some respects is better. Regressions fitting yearly average percent changes in triennial periods and year-to-year data for the 1956 to 1981 period are given below.

1. From one triennium to the next,
   the GNP inflation rate=
   $-.23+1.15$ (the percentage change in M_1 at t–2)
   $(-.35)+(8.40)$
   Adjusted $R^2=.90$
   Standard error=.89
   Durbin-Watson=1.09
2. From one year to the next,
   the GNP inflation rate=
   $.34+.996$ (the percentage change in M_1 at t–2)
   $(.73)\ (10.32)$
   Adjusted $R^2=.81$
   Standard error=1.18
   Durbin-Watson=1.65

PURE SIMULATION INFLATION RESULTS

None of the pure simulations capture the post-Korean War long-run U.S. inflation-money growth relationship. Pertinent data are given in Table III.1.

TABLE III.1.—PURE SIMULATION RESULTS

[Yearly percentage changes in M_1 and the GNP price deflator and selected interest rate levels]

Strategy	Period	Average yearly percent changes in—		Average yearly—		Final year percent change in GNP price deflator	Final year average	
		M_1	GNP price deflator	90-day T-bill rate	Corporate bond rate		90-day T-bill rate	Corporate bond rate
Chase:								
2	1986-90	−0.1	5.51	11.36	10.18	4.98	15.60	10.38
4	1986-90	10.0	6.86	6.97	10.82	6.69	6.02	10.81
1	1983-88	.1	5.99	12.33	12.06	5.33	15.56	11.32
3	1983-88	3.0	6.53	10.51	11.78	5.79	9.15	9.61
DRI:								
2	1987-91	0	7.06	34.62	26.40	7.70	34.32	24.66
4	1987-91	10.0	10.54	4.84	11.37	9.40	5.27	11.66
1	1984-87	0	7.45	55.47	36.46	9.50	75.82	50.86
3	1984-87	3.0	7.08	17.61	15.18	6.80	16.72	15.21
Wharton:								
2	1987	4.0	7.31	22.60	21.23	7.31	22.60	21.23
4	1987	14.0	7.13	5.83	10.45	7.13	5.83	10.45
1	1983-86	4.0	7.22	19.78	19.16	7.58	24.11	23.32
3	1983-86	7.0	7.18	14.80	16.31	7.53	15.50	17.42

The Wharton model projects slightly more inflation with 4.0 percent per year M_2 growth than when it averages 14.0 percent.

The Chase model projects yearly GNP inflation at the end of five years of zero M_1 growth less than 2 percentage points below what it projects after five years of 10.0 percent M_1 growth; 4.98 percent versus 6.69 percent. During the same five-year period, the average yearly inflation rate is 5.51 percent with zero M_1 growth and 6.86 percent per year with 10 percent per year M_1 growth.

For the 1987 to 1991 period, the DRI model projects an end of period yearly GNP inflation rate 1.7 percentage points higher, and average yearly inflation 3.48 percentage points higher, when M_1 growth is 10 percent a year than when it is zero. The pure simulations of the DRI model also project higher inflation (9.5 percent) at the end of four years of zero M_1 growth reached suddenly than at the end of four years of 3 percent M_1 growth reached suddenly.

The failure of the models to generate faster inflation when programmed for faster money growth (and left unmanaged) is consistent with their short-run bias because, as indicated above, in the post-Korean War period in the U.S., inflation increased in the wake of faster money growth with a lag that averaged two years. In the short run, changes in money growth had little effect on the inflation rate. But whatever the reason, the pure simulations of all three models generate long-run inflation-money growth relationships that are at variance with traditional economic theory and contrary to the fundamental facts of recent U.S. economic history.

PURE SIMULATION INTEREST RATE RESULTS

According to modern monetary theory, in the short run, money supply increases tend to reduce nominal interest rates because the increased liquidity is used, in part at least, to buy securities, especially short-term securities such as 90-day Treasury bills. However, in the long run, money supply increases are dissipated in inflation and inflation is the key long-run determinant of nominal interest rates. The theory is that inflation pulls up nominal interest rates by making savers less willing to save and lend and investors more anxious to borrow.

By and large, here as elsewhere, the pure simulation results reflect the short-run bias inherent in the models. Because of the short-run focus of the models, the pure simulations cannot capture the long-run money supply-inflation connection; and inflation is the event that ultimately overwhelms the short-run liquidity effect of changes in money growth on nominal interest rates in the real world.

The pure simulation interest rate results also can be found in Table III.1. Most important, in all pure simulations of the zero M_1 growth scenarios (4 percent M_2 growth in the Wharton simulations) even at the end of four, five, and six years, extremely high nominal short-term interest rates are projected. For example, 90-day Treasury bill rates reach 15.6 percent in the pure Chase simulations of the two zero M_1 growth strategies, 22.6 percent and 24.11 percent in the Wharton simulations of 4 percent M_2 growth, and 34.32 percent and 75.82 percent in DRI's pure simulations of the zero M_1 growth scenarios. The 90-day Treasury bill rates generated by the pure simulations also are high relative to both the corresponding simulation inflation rates and long-term interest rates. These results suggest a liquidity effect that never dissipates. They cannot be believed.

Nor can the interest rate results of the pure simulations of the fast money growth strategy be believed. The pure Chase simulation of the 10 percent per year M_1 growth strategy (reached gradually) projects a 90-day bill rate of only 6.02 percent and a corporate bond rate of 10.81 percent in 1990. The pure DRI simulation of this strategy projects a 5.27 percent 90-day bill rate and a 11.66 percent corporate bond rate at the end of the simulation period. The pure Wharton simulation of 14 percent per year M_2 growth reached gradually projects a 5.83 percent bill rate and a 10.45 percent corporate bond rate in 1987. Given that inflation is virtually unaffected by fast money growth in the pure simulations, savers and lenders would surely reshuffle their portfolios to include more long-term loans with these interest rates, and there is no readily apparent reason why investors and borrowers would be particularly anxious to issue long-term securities with these yields. Thus, it is difficult to see why the 90-day bill rates would remain below the corporate bond rate for very long in the economies that emerge in the pure simulations, even conceding a short-run liquidity effect from fast money growth, particularly since 90-day Treasury bills are both more liquid and less risky than corporate bonds.

Finally, the interest rate results of the pure simulations also are difficult to reconcile with the real GNP growth pure simulation results reported in Chapter II. There is no meaningful association in the results between real GNP growth and "real" interest rates—long-term and short-term.

The Managed Inflation and Interest Rate Results

Inspection of the managed simulation results, which are given in Table III.2, shows that the managers of the DRI and Wharton models did not believe the pure simulation inflation and interest rate results. However, the managers of the Chase model failed to capture very much of the power of increased money growth to result in or at least be associated with increased inflation and the managed simulations of the Chase model still result in very high nominal interest rates both absolutely and relative to inflation under money growth strategies numbers 1, 2, and 3. At the end of five years of 10 percent per year M_1 growth, GNP inflation is only 3.14 percentage points higher than it is at the end of five years of zero M_1 growth. Based on U.S. history in the post-Korean War period, three times as large a differential inflation rate, i.e., 10 percentage points, is expected. With respect to interest rates at the end of six years of zero M_1 growth reached suddenly, for example, the 90-day Treasury bill rate is projected in the Chase managed simulation to average 17.47 percent and the percentage change in the GNP price deflator is projected to be 4.98 percent that year. The projected bill rate is a whopping 12.49 percentage points higher than the projected inflation rate. At the end of five years of zero M_1 growth reached gradually, Chase projects the bill rate to be 19.94 percent and projects the inflation rate to be only 4.71 percent that year.

TABLE III.2.—MANAGED SIMULATION RESULTS

[Yearly percentage changes in M_1 and the GNP price deflator and selected interest rate levels]

		Average yearly percent changes in—		Average yearly—		Final year percent change in GNP price deflator	Final year average	
Strategy	Period	M_1	GNP price deflator	90-day T-bill rate	Corporate bond rate		90-day T-bill rate	Corporate bond rate
Chase:								
2	1936-90	−0.1	5.14	15.01	11.70	4.71	19.94	12.57
4	1986-90	10.0	7.80	9.14	11.36	7.85	9.63	12.06
1	1983-88	.1	5.56	15.11	13.22	4.98	17.47	12.14
3	1983-88	3.0	6.13	11.82	12.17	5.46	10.38	9.88
DRI:								
2	1986-91	0	4.20	8.08	10.37	3.60	6.93	9.51
4	1986-91	10.0	10.36	11.86	14.37	9.80	11.64	14.08
1	1983-91	0	4.37	9.65	11.28	2.50	6.84	9.54
3	1983-91	3.0	7.01	10.39	11.77	6.80	8.36	10.72
Wharton:								
2	1987-91	4.0	3.38	5.90	8.07	2.34	5.69	7.37
4	1987-91	14.0	9.78	12.91	15.97	10.29	12.75	16.53
1	1983-91	4.0	4.32	9.50	11.63	2.07	4.35	6.88
3	1983-91	7.0	5.07	9.97	12.72	3.78	7.04	9.20

The managers of the DRI and Wharton models came much closer to capturing the basic inflation-money growth and nominal interest rate-inflation relationships. With respect to the inflation-money growth linkage, GNP inflation is 6 percentage points higher in DRI's managed simulations when M_1 growth is 10 percent per year than when it is zero. It is 6 to 8 percentage points higher in Wharton's managed simulations when M_2 growth is 14 percent than when it is 4.0 percent. DRI's managed simulations of the sudden deceleration to zero M_1 growth and 3 percent per year M_1 growth strategies result in GNP inflation that averages 2.64 percentage points higher when M_1 growth is 3 percent than when it is zero. Wharton's managed simulations of the sudden deceleration to 4.0 percent and 7.0 percent yearly M_2 growth strategies yield average yearly inflation rates of 4.32 and 5.07 percent.

With respect to the nominal interest rate-inflation linkage also, the managed simulations of the DRI and Wharton models produce reasonably sensible results. Both nominal interest rates and inflation are high under the high money growth strategy and low under the zero money growth strategies. Both also are relatively low in Wharton's managed simulation of the 7 percent per year M_2 growth strategy (number 3). Further, the maximum average difference between simulated 90-day Treasury bill rates and simulated GNP inflation rates is 5.28 percentage points in DRI's managed simulations and 5.18 percentage points in Wharton's. These differences which occur in the sudden deceleration to zero M_1 growth (DRI) and 4.0 percent per year M_2 growth (Wharton) scenarios, are less by far than those that emerged in the pure simulations of the DRI and Wharton models, but still they are relatively high. However, as time passes, these differences erode somewhat; to 4.34 percentage points at the end of the DRI simulation period and 2.28 percentage points at the end of the Wharton simulation period. That pattern seems reasonable. Higher real interest rates are expected to result early on in periods of disinflation because inflation must not only fall, it must remain down before buyers and sellers of bonds adjust their bid and ask prices up and down accordingly.

We note, last, that the DRI and Wharton managed simulations result in corporate bond yields that are higher than the 90-day Treasury bill rates. This pattern is consistent with risk and liquidity differences between the two.

IV. THE TRADE-OFF BETWEEN WAGE INFLATION AND UNEMPLOYMENT

The Phillips Curve

In 1958, A. W. Phillips, an Australian engineer, observed that when wage inflation rose unemployment fell and vice versa. That observation suggested to many economists that unemployment could be reduced by implementing policies to produce more inflation, and vice versa, that inflation could be slowed by putting into effect policies to increase unemployment. However, many other economists objected that any trade-off was a temporary phenomenon. They argued that in the long run unemployment could not be reduced by putting into effect inflationary policies and also that policies that operated to reduce inflation would not increase unemployment permanently.

Results

The simulation results can be used to generate wage inflation-unemployment trade-off functions. In this regard, the pure simulation results reflect the short-run bias inherent in all the models and the managed simulation results reflect attempts to correct this bias. In this latter regard, Chase achieves only a marginal correction.

The Phillips relations implied by the simulations are given in Tables IV.1, IV.2, and IV.3.

TABLE IV.1.—CHASE PHILLIPS TRADE-OFFS

	Pure simulation results			Managed simulation results		
	Yearly M_1 growth	Yearly wage inflation	Unemployment	Yearly M_1 growth	Yearly wage inflation	Unemployment
Run in years:						
2	0.07	5.56	8.82	0.01	5.10	10.46
	3.04	6.40	8.43	2.86	6.05	9.41
	3.62	6.74	8.29	3.41	6.46	9.04
	7.58	7.54	7.98	7.74	7.80	7.25
5	−.04	5.51	8.17	−.32	5.40	9.31
	.01	5.82	7.31	.02	5.27	10.52
	2.97	6.49	7.09	2.73	6.23	8.69
	9.99	8.60	6.00	10.20	9.18	4.63
10	.32	4.92	9.54	.21	5.54	10.62
	.33	5.40	9.43	.51	5.18	9.60
	3.06	5.65	7.29	2.66	5.35	8.78
	9.92	8.89	3.95	10.66	10.37	2.33

TABLE IV.2.—DRI PHILLIPS TRADE-OFFS

	Pure simulation results			Managed simulation results		
	Yearly M_1 growth	Yearly wage inflation	Unemployment	Yearly M_1 growth	Yearly wage inflation	Unemployment
Run in years:						
2	2.50	7.10	9.70	0	5.60	10.60
	4.40	7.20	9.00	3	6.90	9.60
	3.10	7.20	9.60	3	6.20	9.30
	6.40	7.30	8.50	7	9.20	8.00
5	-.10	8.70	6.90	0	4.50	8.00
	1.10	7.60	8.30	0	4.50	8.30
	2.90	7.80	7.60	3	6.90	7.20
	9.20	9.70	4.80	10	12.80	6.60
10				0	4.40	6.50
	0	8.90	5.30	0	4.50	6.40
	3.00	8.10	6.10	3	7.20	6.30
	10.00	10.30	4.80	10	12.70	6.60

TABLE IV.3.—WHARTON PHILLIPS TRADE-OFFS

	Pure simulation results			Managed simulation results		
	Yearly M_2 growth	Yearly wage inflation	Unemployment	Yearly M_2 growth	Yearly wage inflation	Unemployment
Run in years:						
2	4.00	7.39	8.60	4.00	7.37	10.02
	7.80	7.39	8.60	7.80	7.28	9.38
	7.00	7.39	8.60	7.00	7.17	9.76
	9.90	7.39	8.60	9.90	7.71	8.32
5	4.00	9.29	10.53	4.00	5.56	9.50
	4.80	9.40	9.47	4.80	5.95	8.96
	7.00	9.36	9.36	7.00	6.26	8.73
	13.00	9.31	5.19	13.00	11.72	7.74
7 to 10[1]				4.00	1.02	7.60
	4.00	8.33	9.69	4.00	1.73	7.58
	7.00	8.34	9.09	7.00	3.69	5.52
				14.00	13.17	9.09

[1] 7 yr for pure simulation results, 10 for the managed simulation results.

The pure simulations of the Chase model produce a long-run, as well as a short-run, trade-off between wage inflation and unemployment. In fact, the Chase model's implicit long-run Phillips curve appears to be flatter than its short-run Phillips curve. That result for sure is inconsistent with every known economic theory. Chase partly corrects this puzzling result in its managed simulations. In these simulations, the long-run and short-run Phillips curves are approximately parallel. However, we would expect a greater correction, that is, a steeper Phillips curve in the long run than in the short run.

Phillips curves that emerge from the pure simulation results of the DRI model show a steeper long-run relation than in the short-run. However, a trade-off is observed long after we would expect the economy to have fully adjusted to higher inflation and any unemployment gains from courting inflation to have fully dissipated. The managed simulations of the DRI model produce a vertical Phillips curve, but this takes a long time to materialize.

The pure simulations of the Wharton model indicate a nearly flat Phillips curve until the model breaks down (5 years). The managed simulations do not produce a conventional negatively sloped Phillips relation. If anything, there appears to be some upward drift—i.e., higher inflation appears to produce higher unemployment. That result, moreover, is not without empirical foundation. Regression analysis for the United States in the 1969 to 1981 period shows that:

Yearly unemployment =
2.19 + .620 (the yearly percentage increase in the GNP price deflator at t = 1)
(2.70) (5.09)
Adjusted $R^2 = .68$
Standard Error = .78
Durbin-Watson = 2.24

V. MONEY SUPPLY

THE COIN AND CURRENCY TO CHECKING DEPOSITS RATIO

M1 consists of coin, currency, and deposits subject to check in depository institutions. The later are reservable liabilities of commercial banks, S&Ls, MSBs, and credit unions.

M_1 growth occurs if checking deposits grow or if coin and currency increases, or both. If checking deposits grow, reserves must also grow.

Inspection of the zero M_1 growth scenario simulations (4.0 percent per year M_2 growth for Wharton) shows that all three models view coin and currency growth as exogenous, unremitting, and totally unrelated to the growth of checking deposits.

As a result, to achieve zero M1 growth reached suddenly (strategy number 1), the ratio of coin and currency to checking deposits increases sharply and persistently in all simulations. In the DRI pure simulation of this strategy, the ratio rises from .394 in 1982 to .847 in 1988 after which the model breaks down. It rises from .396 in 1982 to .969 in 1991 in the DRI managed simulation. In the Chase simulations (pure and managed) of this strategy, the ratio tops unity in 1991. In the Wharton simulations of 4.0 percent M_2 growth reached suddenly, the ratio reaches .733 in 1986 in the pure simulation after which the model breaks down, and .740 in 1991 in the managed simulation.

These results are not plausible. The public's demands for coin and currency and checking deposits are not independent of one another. Slowing the growth of checking deposits will slow the growth of coin and currency.

If the models were structured to relate demands for coin and currency and checking deposits to one another, zero money growth could be achieved without raising the currency to deposit ratio above a projection of its historic trend. The trend growth of the ratio in the 1970 to 1981 period was 2.7 percent per year. That projects to a coin and currency to transactions deposits ratio of only .50 in 1991. Structured this way, it would not have been necessary for nonborrowed reserves to fall (effectively) to zero as happened in the pure simulations of the Chase and DRI models of strategy number 1, sudden deceleration to zero M_1 growth, and in the managed simulations of this scenario by Chase.

Wharton handles nonborrowed reserves far better than Chase and DRI. Its pure simulation of strategy 1, 4 percent M_2 growth reached suddenly for Wharton, reduces nonborrowed reserves by only 30 percent at the time (1986) the model breaks down (M_1 growth is zero in this simulation). And in Wharton's managed simulation of this strategy nonborrowed reserves are decreased only 20 percent by 1986, and moreover they increase after 1986, returning to the 1982 level in 1991.

In summary, the increases in the coin and currency to checking deposit ratio in the low money growth scenarios are much larger than it is reasonable to believe would occur. In turn, this requires unreasonably large decreases in nonborrowed reserves in the simulations of these strategies.

M_1 AND M_2

Finally, it is interesting to compare M_1 and M_2 growths in the simulations in the subperiods when the M_1 growth which is aimed at is achieved (M_2 growth for Wharton). Relevant data are given in Tables V.1 and V.2.

The results show that the M_2 growth-M_1 growth differential narrows as money growth (M_1 and M_2) increases in all simulations except Wharton's managed simulations. That is consistent with recent U.S. experience, especially in recent years which have been marked by the spread of small denomination time deposits and money market mutual funds which are included in M_2. However, the usual simulation result is somewhat flawed. The size of the differential at low money growth rates is substantially larger in the simulation results than, in fact, it has been historically. Moreover, in Wharton's pure simulations of 4 percent and 7 percent yearly M_2 growth, M_1 growth is significantly below zero for three years or longer, as shown in Appendix A, Table III.

Wharton's managed simulation results pertaining to the relation of M_1 growth and M_2 growth are even more puzzling. The M_2 growth-M_1 growth differentials are larger when M_2 growth is 7 percent a year than when it is 4 percent a year, and larger still when it is 14 percent a year. These results are not consistent with recent U.S. experience.

TABLE V.1.—PURE SIMULATION RESULTS

[Yearly percentage changes in M_1 and M_2]

Model and strategy	Period	Average yearly growth in—	
		M_1	M_2
Chase:			
2	1986–90	−0.10	7.00
4	1986–90	10.00	10.88
1	1983–88	.10	7.24
3	1983–88	3.00	8.36
DRI:			
2	1987–91	0	7.20
4	1987–91	10.00	14.90
1	1984–88	0	7.40
3	1984–88	3.00	9.30
Wharton:			
2	1987	−6.98	4.00
4	1987	12.45	14.00
1	1983–86	−4.03	4.00
3	1983–86	.70	7.00

TABLE V.2.—MANAGED SIMULATION RESULTS

[Yearly percentage changes in M_1 and M_2]

Model and strategy	Period	Average yearly growth in— M_1	Average yearly growth in— M_2
Chase:			
2	1986–90	−0.10	6.76
4	1986–90	10.50	11.34
1	1983–88	0	6.72
3	1983–88	2.90	8.05
DRI:			
2	1986–91	0	5.70
4	1986–91	10.00	13.10
1	1983–91	0	6.00
3	1983–91	3.00	7.90
Wharton:			
2	1987–91	1.48	4.00
4	1987–91	6.51	14.00
1	1983–91	1.21	4.00
3	1983–91	2.85	7.00

VI. SUMMARY AND CONCLUSIONS

Two Opposing Theories

There are two opposing theories, each with wide support among economists concerning the impact of money growth on macroeconomic variables. One dates back centuries and has been advanced by such writers as Henry Thornton in the 19th Century, Irving Fisher in the early part of the 20th Century and Milton Friedman in recent years. The other is relatively new. It traces back to the writings of John Maynard Keynes and Alvin Hansen in the 1930's and 1940's, and has been supported in recent years by Lawrence Klein and James Tobin, among many others. Today, supporters of the new theory also frequently assert the existence of a pleasant Phillips trade-off between inflation and unemployment.

The older theory stresses the purchasing power of money, but not to the exclusion of its liquidity effects. By definition, increases in the quantity of money increase both purchasing power and liquidity. The theory proceeds from the assumption that money and goods and services are substitutes, and so are money and securities and securities and goods and services. Thus, increases in money growth propel portfolio and spending adjustments that lead directly to increases in both nominal GNP growth and securities prices (ergo, decreases in interest rates). Because interest rates fall as a direct and immediate result of increasing money growth, the rate of rise of velocity falls immediately after money growth is increased (money demand rises). However, in time, the interest rate declines are cancelled by increased new securities issues which are impelled by the increased spending on goods and services (nominal GNP growth). As a result, the rate of rise of velocity returns to its initial level and nominal GNP growth thus rises percentage point for percentage point with increases in money growth.

Further, although at first the increased spending on goods and services tends to increase the growth of real GNP, if the increase in money growth persists, in time, it is fully dissipated in increased inflation. That, in turn, leads to still more new securities issues and to reduced saving, and as a result interest rates rise. The final results of increased money growth are:

—proportionately faster nominal GNP growth,
—proportionately higher inflation, and
—commensurately higher interest rates.

There are no permanent changes in the rate of rise of money's velocity, real GNP growth or unemployment although initially the first tends to fall, the second tends to rise and the third tends to fall.

Vice versa, the final results of decreased money growth are:

—proportionately slower nominal GNP growth,
—proportionately slower inflation, and
—lower interest rates.

In the long run, there are no changes in the rate of rise of velocity, real GNP growth, or unemployment, although in the short run the first may rise, the second tends to fall and the third tends to increase.

In contrast, the newer theory stresses the liquidity effects of money growth. Often its followers deny any purchasing power impact. The newer theory proceeds from the assumption that only money and securities are substitutes. Strict interpretation of the theory rules out substitution between money and goods and services. That means that changes in money growth cannot directly influence the economy's goods and services sector. Changes in money growth can affect the goods and services sector only via their effects on securities prices (i.e., interest rates).

As noted, in the new theory, increases in the quantity of money increase liquidity. In turn, increases in liquidity impel the public to increase securities purchases, especially purchases of short-term securities. Thus, increases in money growth lead directly to bidding down interest rates, especially short-term interest rates. In turn, the fall in interest rates induces the public to increase both its demand for money (nominal money balances) and its demands for investment goods and durable goods. The investment multiplier assures increases in spending also on nondurable consumer goods. Thus, nominal GNP growth is increased by increases in money growth. However, nominal GNP growth does not increase percentage point for percentage point with the acceleration of money growth. The growth of nominal GNP is less than that of the money supply because of the increase in money demand that is impelled by the bidding down of interest rates. The increase in money demand registers as a fall in the rate of rise of velocity.

Given a pleasant Phillips trade-off, the rise in nominal GNP growth that does occur registers mainly in increased real GNP growth. As a result, unemployment falls. Inflation is little changed by increases in money growth.

The final results of increased money growth in the new theory are:
—faster nominal GNP growth, but not percentage point for percentage point,
—higher real GNP growth,
—lower unemployment,
—a less than proportional increase in the rate of inflation,
—lower interest rates, especially short-term interest rates, and
—a lower rate of rise in velocity.

Vice versa, the final results of reduced money growth are:
—slower nominal GNP growth, but not percentage point for percentage point,
—lower real GNP growth,
—higher unemployment,
—a less than proportional fall in inflation,
—higher interest rates, especially short-term interest rates, and
—a faster rate of rise in velocity.

SUMMARY OF SIMULATION RESULTS

The pure simulation results reflect the new view. All three models generate nearly offsetting changes in velocity as money growth is increased and only small increases in nominal GNP growth.

Second, all three models, when simulated without management, generate substantially lower unemployment under the high money growth strategy (number 4) than under the moderate and no money growth strategies in years when money growth is roughly equal to the programmed strategy rates. This result is especially surprising because real GNP growth is increased only marginally by faster money growth in the pure simulation of the Chase model, only a little more than 1 percent a year in the pure simulation of the Wharton model and actually is lower under the high money growth strategy in the pure simulation of the DRI model.

Finally, in the pure simulations, all three models generate significantly lower interest rates under the high money growth strategy, and inflation is virtually the same no matter what money growth is except in the pure simulation of the DRI model which generates 4 percent per year higher inflation when M_1 growth is 10 percent a year than when it is zero. But even this latter result falls far short of the effect expected under the older theory of the impact of money growth on the marcoeconomy.

The managed simulation results are very different in the cases of the DRI and Wharton models but only marginally different in the case of the Chase model. Moreover, the results generated by the managed simulations of the DRI and Wharton models still fall short of the results that traditional economic theory predicts.

In the managed simulations of the Wharton model, nominal GNP growth is 6.1 percent a year higher when M_2 growth is 14 percent a year than when it is 4 percent a year. In the managed simulations of the DRI model, nominal GNP growth is 5.8 percent a year higher when M_1 growth is 10 percent a year than when it is zero. These results provide limited support for the abstract conclusions of traditional economic theory. However, in the managed simulations of the Chase model, nominal GNP growth is only 3.3 percent a year higher when M_1 growth is 10 percent a year than when it is zero. Thus, the absorption of increased money growth in slower velocity growth, which was 70 percent to 90 percent in the pure simulations, is reduced in the managed simulations, but only to 40 percent (DRI and Wharton)to 70 percent (Chase), not to zero as traditional economic theory predicts.

Second, in the managed simulations, real GNP growth follows the expected time track in all three cases. Under the high money growth strategy (number 4), real GNP growth is high initially and then slows, while under the other strategies it is low at first, rises in the middle years of the simulation period and then recedes somewhat. In the managed simulations of the DRI and Wharton models, high-money growth does not permanently increase real GNP growth. Indeed, real GNP growth is less, on average, in the managed simulations of both the DRI and Wharton models under the high-money growth strategy than under the low- and no-money growth strategies. Real GNP growth averages one-half percent higher when M_1 growth is 10 percent a year than when it is zero in the managed simulations of the Chase model.

Third, in the managed simulations of the Chase model, unemployment is significantly lower in the high than in the moderate and no money growth strategies. This is a bewildering result in view of

Chase's managed simulation real GNP growth results. In contrast, unemployment is virtually the same across money growth scenarios in the DRI and Wharton managed simulations, as traditional economic theory predicts.

Finally, the managed simulations of the DRI and Wharton models produce inflation and interest rate results that are far closer to what traditional theory predicts for different money growth scenarios than to what the new theory predicts. Comparing final year results for strategies 2 and 4, inflation increases by about .60 percentage points for each percentage point increase in money growth in the managed simulations of the DRI model and .80 percentage points in the managed simulations of the Wharton model. And interest rates, short term as well as long term, are lower when money growth is low. However, in the managed simulations of the Chase model, higher interest rates result when money growth is low, and inflation is relatively insensitive to faster money growth. It increases only .31 percentage points for each percentage point increase in money growth, comparing 1990 results for zero and 10 percent per year M_1 growth.

In summary, the DRI and Wharton managed simulations provide limited support for the abstract conclusions of traditional monetary theory. The Chase managed simulations do not. The theory predicts percentage point for percentage point increases in nominal GNP growth, inflation and interest rates with increased money growth, and no lasting changes in real GNP growth or unemployment. In these regards,

—The DRI and Wharton managed simulations predict substantial increases in nominal GNP growth, inflation and interest rates with faster money growth, but not percentage point for percentage point. The Chase managed simulations predict only relatively minor increases in nominal GNP growth and inflation and actually show lower interest rates with higher money growth.

—In all managed simulations, real GNP growth follows the expected time pattern, rising at first with faster money growth and then receding. In the DRI and Wharton managed simulations, real GNP growth averages more with low money growth, and unemployment is unaffected by money growth in the long run. However, in the Chase managed simulations, real GNP growth averages slightly higher with high money growth than with moderate or no money growth, and unemployment is much lower with fast money growth.

Conclusions

A new theory is not necessarily better than an old one. U.S. economic history since the Korean War confirms the traditional theory of the long-run effects of money growth on macroeconomic variables. As money growth rose in the late 1960's and the 1970's, nominal GNP increased percentage point for percentage point, not instantly but in a year or so. The rate of rise of velocity (M_1 velocity) was unchanged. Neither real GNP growth or unemployment were increased. Rather, fast money growth was dissipated fully in faster inflation and higher interest rates.

In the abstract, optimal M_1 growth is zero, for in the abstract, money growth is fully dissipated in inflation and interest rates rise commensurately. Zero may seem unduly "tight," but given our experience in recent years, the goal of monetary policy should be to slow the growth of M_1 to zero and certainly to no higher than 3 percent a year. Although they do not support the abstract conclusions of traditional monetary theory, the managed simulations, for sure the DRI and Wharton runs, support this policy conclusion. They indicate that 10 percent per year M_1 growth (14 percent per year M_2 growth in the Wharton model) will generate significantly more inflation and higher interest rates than zero or 3 percent per year M_1 growth (4 percent a year and 7 percent a year M_2 growth) but provide no lasting stimulus to either real GNP growth or employment. Second, they show that zero M_1 growth (4 percent a year M_2 growth in the Wharton simulations) will produce lower inflation and interest rates and roughly the same real GNP growth and unemployment rate as 3 percent a year M_1 growth (7 percent a year M_2 growth in the Wharton simulations). However, they provide little reason to choose between the gradual and quick paths to zero money growth.

In closing, we stress that monetary policy must be made for the long run because it has effects over long periods of time and sometimes these effects are delayed and sometimes they are opposite of the short-run effects. In past years, the Federal Reserve created serious inflation and interest rate problems by ignoring the long-run effects of fast money growth, and thereby laid the foundation for periodic recessions. Some would argue that, nonetheless, the Federal Reserve still should accelerate money growth now because that would lower interest rates and boost real GNP and employment in the short run, and an increase in money growth need not be maintained indefinitely. However, if it is not maintained indefinitely, an acceleration to a higher level of money growth now must be reversed by a commensurate deceleration later on. That would produce unwelcome effects on interest rates, real GNP growth and employment later on, and possibly at the same time that the short-run benefits of accelerating money growth in the first place were being replaced by the long-run costs that acceleration of money growth produces sooner or later. There is no free lunch in economics. Slowing M_1 growth to zero to 3 percent a year is the proper policy for the Federal Reserve to pursue now and steady as she goes is the proper policy after that range is reached.

APPENDIX 1

CHASE NOTES

"PURE" MONETARY POLICY SIMULATIONS

In the "pure" monetary policy simulations, changes were made to the non-borrowed monetary base less currency, the principal exogenous monetary sector variable in the Chase model and to the discount rate, a secondary exogenous variable. These changes were specified such that the growth rate in the money supply (M_1) would grow at the rate specified by GAO in each simulation.

The only exception occurred in the simulations in which money supply was forced to grow at a 0 percent annual rate. The problem was that maintaining zero growth in the money supply required an actual decrease in the non-borrowed monetary base (less currency). After seven years of such policies, the model was driven well outside its sample range and the non-borrowed monetary base less currency approached zero. Since it made no sense to drive this variable below zero, the money supply was allowed to grow more rapidly in the latter years of the simulation. In our view, the need to drive the model with non-borrowed reserves approaching zero stemmed from the extreme nature of the zero monetary growth assumption.

MANAGED MONETARY GROWTH SCENARIOS

In the second set of simulations, we applied the same set of changes as in the first set, except that some additional changes which we felt were necessary to get a balanced portrayal of the economy were also entered. These additional changes fell into several categories. The first category reflected the changed nature of the monetary sector in the United States which is not yet incorporated into the Chase Econometrics Macroeconomic Model. (A new monetary sector will be incorporated into the model this summer which will both capture the new relationships within the monetary sector of the United States and will reflect more recent data.) In particular, the nature of money supply targeting (since late 1979) means that changes in the monetary base designed to affect the money supply aggregates will have more of an impact upon interest rates than appear in the current (old) version of the model. Thus, the Federal funds rate was raised by approximately 4.5 percentage points in the 0 percent growth rate scenario and 2.3 percentage points in the 3 percent growth rate scenario. In addition, the index of credit rationing was altered to reflect that monetary conditions were as tight as they ever have been in the post-war period in the 0 percent growth simulations and as tight as they have been 98 percent of the time in the 3 percent growth simulation.

A second set of changes was necessary in the foreign trade sector. The exogenous trade weighed value of the dollar was reduced to account for the exchange rate effects of a tighter monetary policy and higher interest rates. The endogenous foreign trade component naturally responded to this change in relative prices automatically. However, the exogenous components, exports of services, imports of services, and exports of agricultural goods were all adjusted to reflect the change in the relative price competitiveness of dollar denominated goods in the international market.

Some changes were also necessary because the monetary policy changes had a significant impact upon inflation. Components of Federal and State and local government expenditures which are exogenous in current dollars in the Chase Model were adjusted by the changes in the relevant inflation indices to keep them constant in real terms. Specifically purchases of goods and services were adjusted by the changes in the GNP price deflator and government transfer payments were adjusted by the changes in the Consumer Price Index. Therefore, while the pure simulation assumed unchanged nominal government expenditures, the managed simulation assumed an unchanged real level of government expenditures.

Finally, some of the scenarios required individual changes. In the scenarios in which monetary growth was 0 percent, interest rate fluctuations occurred as non-borrowed reserves approached zero. This had an impact of raising the prime rate relative to other interest rates. Therefore, in the years 1986 and beyond, the prime rate in the managed 0 percent monetary growth scenarios was adjusted to follow the other interest rates in the model more closely.

The last change occurred in the managed 10 percent monetary growth scenario. An unchanged real level of Federal expenditures, despite a period of very rapid monetary growth, led to large budget surpluses in this scenario. As a result, the amount of Federal debt outstanding fell precipitously and the Treasury bill rate reached levels far lower than the other interest rates in the model. In order to keep the model from reacting in this fashion, the Treasury bill rate was adjusted to keep it in line with the other interest rates in this scenario.

INPUT FILES TO SIMULATIONS

SUDDEN 3% M1 GROWTH RATE PURE SIMULATION

```
GAD11 -

&MACSIM
OPEN MLTM;
OUTPUT ANN TO TERMINAL;
GROUP CREATE 'GADVARS NMBXC M1B M2 MCUR MBASE GNP GNPZ PGNP PCIUS UN
     WRTPA RFF R3ANC RCP RCMDR RPCB RTB GFDEF RDISW;

CHANGE NMBXC FROM 82 0 ADD -4.43 -9.20 -13.87 -19.07 -25.26
     -32.49 -39.88 -47.98 -56.12 -65.61;
CHANGE NMBXC FROM 88 0 ADD .44 1.13 2.18 3.80; ← Nonborrowed reserves
CHANGE RDISW FROM 82 0 ADD 10*.7; Rediscount Rate, NY Fed. Res Bank
SIMULATE 82 1 TO 91 4;
```

SUDDEN 0% M1 GROWTH RATE PURE SIMULATION

```
GAD21 -

&MACSIM
OPEN MLTM;
OUTPUT TO TERMINAL ANN;
GROUP CREATE 'GADVARS NMBXC M1B M2 MCUR MBASE GNP GNPZ PGNP PCIUS UN
     WRTPA RFF R3ANC RCP RCMDR RPCB RTB GFDEF RDISW;

CHANGE NMBXC FROM 82 0 ADD -8.44 -17.29 -26.07 -35.44 -45.93
     -57.61 -69.61 -82.52 -95.69 -110.5;
CHANGE NMBXC FROM 88 0 ADD 6.61 13.35 21.19 30.98;
CHANGE NMBXC FROM 88 0 TO .1 .07 .03 .01;
CHANGE RDISW FROM 82 0 ADD 10*1.5;
SIMULATE 82 1 TO 91 4;
```

GRADUAL 10% M1 GROWTH RATE MANAGED SIMULATION

```
GAD4A4 -

$MACSIM
OPEN MLTMMAR;
OUTPUT ANN TO TERMINAL;
GROUP CREATE 'GADVARS NMBXC M1B M2 MCUR MBASE GNP GNPZ PGNP PCIUS UN
     WRTPA RFF R3ANC RCP RCMOR RPCB RTB GFDEF;
GROUP CREATE 'GADVARS2 CRED IHSM RDISW TWA EXAG EXSV IMSV;
GROUP CREATE 'GADVARS3 GFDRZ GFNDRZ GFSVZ GFSTZ GSLDRZ GSLNDZ GSLSVZ
     GSLSTZ TRSSG TRVET OTHF TRAFDC WRGM WRGCM WRGCF WRGSL TRSUB;

CHANGE NMBXC FROM 82 0 ADD .64 2.53 6.29 11.70 18.75
     26.33 35.55 46.11 58.98 73.14;
CHANGE NMBXC FROM 89 0 ADD -.62 -.93 -2.18;
CHANGE RFF FROM 82 0 ADD 10*-1.5;   FEDERAL FUNDS RATE
CHANGE RDISW FROM 82 0 ADD 10*-1.5;

CHANGE CRED FROM 82 1 TO -.15 -.3 -.45 -.6 -.75 -.9 -1.05 -1.2 -1.35,
     -1.5 -1.65 -1.8 -1.95 -2.1 -2.25 -2.4 -2.55, 23*-2.7;
CHANGE GFDRZ GFNDRZ GFSVZ GFSTZ GSLDRZ GSLNDZ GSLSVZ GSLSTZ FROM 82 0
     PCT 0 .24 .51 1.30 2.13 3.44 4.73 6.26 7.96 9.88;
CHANGE TRSSG TRVET OTHF TRAFDC WRGM WRGCM WRGCF WRGSL FROM 82 0
     PCT -.14 -.25 -.14 .27 .74 1.33 2.14 3.21 4.52 6.12;
CHANGE RTB FROM 86 0 ADD 2 3 4 5 6 7;   3 MONTH TREASURY BILL YIELD

SIMULATE 82 1 TO 91 4;
```

Federal [illegible] Fed Purch. Nondefense [illegible] Fed Purch. Services Fed Purch. Structures State & Local [illegible] S&L Purch. [illegible] S&L Purch. Services S&L Purch. Structures

IMP. WAGE [illegible]

TAXES, FAM. [illegible] [illegible]

OTHER GOV'T TRANS PAY

IMP. [illegible], CIVILIAN [illegible]

FED. TRANS. PAYMENTS

TRANS PAYMENTS, VETERANS

GRADUAL 0% M1 GROWTH RATE PURE SIMULATION

```
GAD31 -

&MACSIM
OPEN MLTM;
OUTPUT ANN TO TERMINAL;
GROUP CREATE 'GADVARS NMBXC M1B M2 MCUR MBASE GNP GNPZ PGNP PCIUS UN
     WRTPA RFF R3ANC RCP RCMOR RPCB RTB GFDEF RDISW;

CHANGE NMBXC FROM 82 0 ADD -2.03 -5.91 -11.43 -19.26 -29.92
     -41.67 -53.63 -66,39 -79.31 -93.75;
CHANGE NMBXC FROM 90 0 TO .1 .01;
CHANGE RDISW FROM 82 0 ADD .3 .6 .9 1.2, 5*1.5;
SIMULATE 82 1 TO 91 4;
```

GRADUAL 10% M1 GROWTH RATE PURE SIMULATION

```
GAD41 -

$MACSIM
OPEN MLTM;
OUTPUT ANN TO TERMINAL;
GROUP CREATE 'GADVARS NMBXC M1B M2 MCUR MBASE GNP GNPZ PGNP PCIUS UN
     WRTPA RFF R3ANC RCP RCMOR RPCB RTB GFDEF RDISW;

CHANGE NMBXC FROM 82 0 ADD .64 2.53 6.29 11.70 18.75
     26.33 35.55 46.11 58.98 73.14;
CHANGE NMBXC FROM 89 0 ADD -.62 -.93 -2.18;
CHANGE RDISW FROM 82 0 ADD 10*-1.5;
SIMULATE 82 1 TO 91 4;
```

SUDDEN 3% M1 GROWTH RATE MANAGED SIMULATION

```
GAD1A3 -

$MACSIM
OPEN MLTMMAR;
OUTPUT ANN TO TERMINAL;
GROUP CREATE 'GADVARS NMBXC M1B M2 MCUR MBASE GNP GNPZ PGNP PCIUS UN
     WRTPA RFF R3ANC RCP RCMDR RPCB RTB GFDEF;
GROUP CREATE 'GADVARS2 CRED IHSM RDISW TWA EXAG EXSV IMSV;
GROUP CREATE 'GADVARS3 GFDRZ GFNDRZ GFSVZ GFSTZ GSLDRZ GSLNDZ GSLSVZ
     GSLSTZ TRSSG TRVET OTHF TRAFDC WRGM WRGCM WRGCF WRGSL TRSUB;

CHANGE NMBXC FROM 82 0 ADD -4.43 -9.20 -13.87 -19.07 -25.26
     -32.49 -39.88 -47.98 -56.12 -65.61;
CHANGE NMBXC FROM 88 0 ADD .44 1.13 2.18 3.80;
CHANGE RFF FROM 82 0 ADD 10◆.7;
CHANGE RDISW FROM 82 0 ADD 10◆.7;

CHANGE CRED FROM 82 1 TO 1.2 1.4 1.6 1.8 1.9, 35◆2.0; INDEX OF CREDIT RATIONING
CHANGE IHSM FROM 82 1 ADD 40◆-.1; MULTI FAMILY PRIVATE HOUSING STARTS
CHANGE RFF RDISW FROM 82 0 ADD 10◆1.5;
CHANGE TWA FROM 82 0 ADD 10◆-2.5; TRADE WEIGHTED VALUE OF DOLLAR
CHANGE EXAG FROM 82 1 ADD 0 -.25 -.5 -.75 -1 -1.25 -1.5 -1.75 -2,
     -2.25, 30◆-2.5; AGRICULTURAL EXPORTS
CHANGE EXSV FROM 82 1 ADD 0 -.25 -.5 -.75 -1 -1.25 -1.5 -1.75, 32◆2.0;
CHANGE IMSV FROM 82 1 ADD 0 .25 .5 .75, 36◆1;                   ↖ EXPORTS,
          ↖ IMPORTS, SERVICES                                     SERVICES
CHANGE GFDRZ GFNDRZ GFSVZ GFSTZ GSLDRZ GSLNDZ GSLSVZ GSLSTZ FROM 82 0
     PCT -.01 -.4 -.7 -1.33 -2.03 -2.78 -3.62 -4.54 -5.5 -6.5;
CHANGE TRSSG TRVET OTHF TRAFDC FROM 82 0
     PCT .3 .3 .16 -.52 -.89 -1.43 -2.09 -2.79 -3.58 -4.44;
CHANGE WRGM WRGCM WRGCF WRGSL FROM 82 0
     PCT .3 .3 .16 -.52 -.88 -1.43 -2.09 -2.79 -3.58 -4.44;

SIMULATE 82 1 TO 91 4;
```

SUDDEN 0% M1 GROWTH RATE MANAGED SIMULATION

```
6A02A8 -

%MACSIM
OPEN MLTM;
OUTPUT TO TERMINAL ANN;
GROUP CREATE 'GADVARS NMBXC M1B M2 MCUR MBASE GNP GNPZ PGNP PCIUS UN
     WRTPA RFF R3ANC RCP RCMDR RPCB RTB GFDEF;
GROUP CREATE 'GADVARS2 CRED IHSM RDISW TWA EXAG EXSV IMSV;
GROUP CREATE 'GADVARS3 GFDRZ GFNDRZ GFSVZ GFSTZ GSLDRZ GSLNDZ GSLSVZ
     GSLSTZ TRSSG TRVET OTHF TRAFDC WRGM WRGCM WRGCF WRGSL TRSUB;

CHANGE NMBXC FROM 82 0 ADD -9.44 -17.29 -26.07 -35.44 -45.93
     -57.61 -69.61 -82.52 -95.69 -110.5;
CHANGE NMBXC FROM 88 0 ADD 6.61 13.35 21.19 30.98;
CHANGE NMBXC FROM 88 0 TO .1 .07 .03 .01;
CHANGE RFF FROM 82 0 ADD 10*1.5;
CHANGE RDISW FROM 82 0 ADD 10*1.5;

CHANGE CRED FROM 82 1 TO 1.7 2.0 2.5 2.7 2.9, 35*2.99;
CHANGE IHSM FROM 82 1 TO .3 .29 .28 .27 .26 , 35*.25;
CHANGE RDISW FROM 82 0 ADD 10*3.0;
CHANGE RFF FROM 82 0 ADD 10*3.0;
CHANGE TWA FROM 82 0 ADD 10*-5;
CHANGE EXAG FROM 82 1 ADD 0 -.5 -1 -1.5 -2 -2.5 -3 -3.5 -4 -4.5, 30*-5;
CHANGE EXSV FROM 82 1 ADD 0 -.5 -1 -1.5 -2 -2.5 -3 -3.5 , 32*-4;
CHANGE IMSV FROM 82 1 ADD 0 .5 1 1.5, 36*2;

CHANGE IHUM EXOGENIZE;← UNSOLD NEW SINGLE FAMILY HOMES

CHANGE GFDRZ GFNDRZ GFSVZ GFSTZ GSLDRZ GSLNDZ GSLSVZ GSLSTZ FROM 82 0
     PCT .03 -.69 -1.58 -2.95 -4.06 -5.38 -6.66 -8.04 -9.42 -10.34;
CHANGE TRSSG TRVET OTHF TRAFDC FROM 82 0
     PCT .56 .48 .23 -1.13 -1.79 -2.61 -3.57 -4.67 -5.45 -6.31;
CHANGE WRGM WRGCM WRGCF WRGSL FROM 82 0
     PCT .56 .48 .23 -1.13 -1.79 -2.61 -3.57 -4.67 -5.45 -6.31;

CHANGE NMBXC FROM 82 0 ADD .5 .8 1.3 1.5 2.0 2.2 2.1;

CHANGE RPCB FROM 86 1 ADD 4*-.25, 4*-.35, 4*-.45, 4*-.55, 4*-.65, 4*-.75
;          ↖ PRIME RATE, COMM. BANK LOANS
SIMULATE 82 1 TO 91 4;
```

GRADUAL 0% M1 GROWTH RATE MANAGED SIMULATION

```
GAD3A2 -

&MACSIM
OPEN ML_TM;
OUTPUT ANN TO TERMINAL;
GROUP CPEATE 'GADVARS NMBXC M1B M2 MCUR MBASE GNP GNPZ PGNP PCIUS UN
     WRTPA RFF R3ANC RCP RCMOR RPCB RTB GFDEF;
GROUP CREATE 'GADVARS2 CRED IHSM RDISW TWA EXAG EXSV IMSV;
GROUP CREATE 'GADVARS3 GFDRZ GFNDRZ GFSVZ GFSTZ GSLDRZ GSLNDZ GSLSVZ
     GSLSTZ TRSSG TRVET DTHF TRAFDC WRGM WRGCM WRGCF WRGSL TRSUB;

CHANGE NMBXC FROM 82 0 ADD -2.03 -5.91 -11.43 -19.26 -29.92
     -41.67 -53.63 -66,39 -79.31 -93.75;
CHANGE NMBXC FROM 90 0 TO .1 .01;
CHANGE RFF FROM 82 0 ADD .3 .6 .9 1.2, 5*1.5;
CHANGE RDISW FROM 82 0 ADD .3 .6 .9 1.2, 5*1.5;

CHANGE CPED FROM 82 1 TO 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0
     2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9, 21*2.99;
CHANGE IHSM FROM 82 1 TO .34 .34 .33 .33 .32 .32 .31 .31,
     .30 .30 .29 .29 .28 .28 .27 .27 .26 .26, 22*.25;
CHANGE RFF RDISW FROM 82 0 ADD 1 1.5 2 2.5 , 6*3;
CHANGE TWA FROM 82 0 ADD -1 -2 -3 -4 -5, 5*-5;
CHANGE EXAG FROM 82 1 ADD 0 -.25 -.5 -.75 -1 -1.25 -1.5 -1.75 -2,
     -2.25 -2.5 -2.75 -3 -3.25 -3.5 -3.75 -4 -4.25 -4.75 -5, 29*-5;
CHANGE EXSV FROM 82 1 ADD 1 -.25 -.5 -.75 -1 -1.25 -1.5 -1.75 -2,
     -2.25 -2.5 -2.75 -3 -3.25 -3.5 -3.75 -4, 23*-4;
CHANGE IMSV FROM 82 1 ADD 0 .25 .5 .75 1 1.25 1.5 1.75, 32*2;

CHANGE GFDPZ GFNDRZ GFSVZ GFSTZ GSLDRZ GSLNDZ GSLSVZ GSLSTZ FROM 82 0
     PCT .01 -.24 -.65 -1.44 -2.32 -3.46 -4.68 -6.00 -7.29 -8.83;
CHANGE TRSSG TRVET DTHF TRAFDC FROM 82 0
     PCT .07 .04 -.09 -.51 -.94 -1.56 -2.31 -3.19 -4.03 -5.15;
CHANGE WRGM WRGCM WRGCF WRGSL FROM 82 0
     PCT .07 .04 -.09 -.51 -.94 -1.56 -2.31 -3.19 -4.03 -5.15;

CHANGE RPCB FROM 86 1 ADD 4*-.25, 4*-.35, 4*-.45, 4*-.55, 4*-.65, 4*-.75
;
SIMULATE 82 1 TO 91 4;
```

APPENDIX 2

DRI NOTES

SIMULATIONS OF ALTERNATIVE MONEY-GROWTH PATHS

Four ten-year simulations of the DRI annual scenario model have been run, incorporating different assumptions about the rate of growth of the money supply, M_1.

The assumed growth paths are:

1. M_1 grows at 3 percent per year.
2. M_1 growth is phased up to 10 percent per year over a five-year period.
3. M_1 growth is decelerated to 0 percent per year over a five-year period.
4. M_1 grows at 0 percent per year.

Implementation

It should first be stated that the velocity of money is *not* explicitly dominated by time in the scenario model. Put another way, there is no *explicit* relationship which posits that real money balances in some distant years, say 1991, are essentially exogenous. If this were the case, then differences in money growth paths would ultimately and automatically be translated into equivalent differences in inflation.

Even without such an explicit relationship, it is still possible that the model would, in the long run, conform with this view of quantity theorists. The infusion of more money drives down interest rates and stimulates interest-sensitive components of demand, thus increasing inflationary pressures. In the long run, permanent gains in output can come only if *supply* is permanently increased, but the price level (and possibly the rate of inflation) will be permanently higher. The velocity of money *may*, however, differ across various money-growth regimes.

With no user management, the scenario model signals that almost all differences in money growth are ultimately offset by opposite changes in velocity. The best interpretation of this is as follows: Left unmanaged, the scenario model neither proves nor disproves the long-run exogeneity of velocity of money. This should not be a surprising result to experienced model-builders: without explicit incorporation of this exogeneity it is highly unlikely that such a result would fall out of the full system dynamics of the model. And, of course, explicit incorporations of this exogeneity would not *prove* it to be true either.

Why does the model, unaided, not produce a more monetarist result? The result would seem to be as follows: More money, as mentioned earlier, stimulates demand. Since interest rates fall and investment in particular is stimulated, it tends also to stimulate *supply*. Thus, the economy's rate of utilization, the major determinant of inflationary pressures in the scenario model, is not greatly affected. In addition, productivity is higher and, celeris paribus, unit labor costs (another important determinant of inflation) are lower.

This wage-price block of the scenario model is considerably less detailed than that in DRI's quarterly model of the U.S. economy. The latter model adopts a "stage-of-processing" approach to price formation, with many more points of linkage by which inflation can be transmitted through the economy. For a similar experiment it would thus give a more realistic inflation result.

To incorporate such a detailed wage-price block in the scenario model would seriously unbalance it. The only way to increase the response of inflation would be to link inflationary *expectations* to money growth. The present scenario model is the first released by DRI—such a change may be incorporated in subsequent versions.

Thus, it becomes a matter of user judgement whether or not the velocity of money is treated as exogenous in the long run. In the simulations prepared so far, this exogeneity has been assumed. Thus, the results of the various simulations are best described as alternative monetarist viewpoints of how the world may unfold; they neither confirm nor deny the levels of monetarism.

The model was made to conform with a monetarist view by manipulating the rate of growth of wage to obtain the necessary inflation response. The only other changes which were found to be necessary were as follows:

—Short-term interest rates were monitored and the three-month Treasury bill rate was add-factored to ensure, for example, that it fell initially, but then rose in line with the higher rate of inflation when money growth was raised.

—Certain components of final demand were add-factored to prevent them from overreaching to different money growth/interest rate regimes. These included investment-producers' durable equipment, investment in nonresidential construction, housing stocks, and consumption of motor vehicles. The probable reason for having to add-factor these variables is the weakness of the long-run stock adjustment mechanisms in the model's equations. Thus, for example, it is possible for lower interest rates to lead to permanently higher housing stocks and hence to a permanently farther-growing housing stock.

—The model's predicted movement in the unemployment rate in the early years of a change in monetary regime was accentuated by add-factoring the unemployment rate. This is a relatively minor change, contributing somewhat to the inflation outcome of the various simulations.

APPENDIX 3

WHARTON NOTES

The effect of changing the growth rate of the money supply (M2) was simulated on the Wharton Annual and Industry Model (the long-term model). The year-to-year growth rates for M2 for each of the scenarios and for the Wharton baseline (the April 1982 baseline forecast) are shown below:

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Base
1982	8.8	8.8	8.8	8.8	8.8
1983	7.0	4.0	7.8	9.9	8.6
1984	7.0	4.0	6.8	11.0	9.2
1985	7.0	4.0	5.8	12.0	10.9
1986	7.0	4.0	4.8	13.0	10.8
1987	7.0	4.0	4.0	14.0	10.5
1988	7.0	4.0	4.0	14.0	9.2
1989	7.0	4.0	4.0	14.0	10.0
1990	7.0	4.0	4.0	14.0	9.4
1991	7.0	4.0	4.0	14.0	10.0

Two of the scenarios propose a monetary growth path radically different from that of both the baseline and historical experience. Over the last decade, M2 has grown as rapidly as 13.2% (1976), and as slowly as 6.2% (1974), but it has generally remained within the 8.5% to 12.5% range. The assumptions of the first two scenarios are therefore quite extreme, and the remaining scenarios, though more in line with historical experience, also are very strong assumptions. Because of this large departure from both the baseline and the historical norm, judgmental adjustments must be made in order to accurately simulate the behavior of the economy under the specified assumptions.

If the short-run model (Quarterly Model) had been used, fewer adjustments would have been necessary. The specifications of the long-run model, however, were developed with particular attention to preserving the fundamental relationships which have characterized the growth of the U.S. in the post-war period. These relationships include constant returns to scale and the long-run constancy of such ratios as the personal savings rate and the wage share of national income. At times it was necessary to sacrifice some of the short-term sensitivity of these specifications in order to enhance the long-term properties of the model. For example, housing starts are much more dependent on the underlying demographics (such as household formation) in the long-run model, whereas financial market conditions have relatively more weight in the short-run model. Therefore, judgmental adjustments to the model are necessary in order to capture the impact in the initial years of the scenarios that impart a severe monetary shock. The advantage of using the long-run model lies in its ability to accurately simulate the ultimate or "steady-state" effects of the various monetary policies.

The adjustments that were made for each of the scenarios are detailed below. In general, however, the adjustments fall into four categories: interest rates, the savings rate, the level of expenditure on interest rate-sensitive sectors, and the rate of change in the real wage. The reasons for the adjustments are as follows:

1. Interest rate adjustments

In the model, long-term interest rates are determined as a weighted average of the level of current and past short-term rates. The lag structure is three years. Short-term rates are a function of inflationary expectations (which are formed as a weighted average of the current year's and the three previous years' changes in the GNP deflator), and velocity.

If the growth rate of the money supply is suddenly reduced, and held at that low rate of growth, the lags for the adaptive expectations procedure used to determine price expectations are likely to be shortened, and if the policy is steadily applied the current year's price change would carry more weight in the formation of expectations. In the impact year, however, the price expectations would not be certain of the future stability of monetary policy, and the liquidity crunch would initially drive interest rates up. This effect is partially captured by the velocity variable.

Because the shock is outside of the historical range, the initial increase in the short-term interest rate due to the increase in velocity may be understated, and interest rates are adjusted upward in the initial years of the first three scenarios. They are adjusted downward somewhat in later years to account for the shortening lag on the formation of price expectations. The lags on the long-term rate are similarly shortened.

2. Savings rate adjustments

Both consumption and personal disposable income are behaviorial relations in the model, so savings is determined as a residential, the difference between disposable income and consumption. In the first three scenarios, the savings rate was adjusted upward (which is tantamount to adjusting consumption expenditures downward proportionally across-the-board). This was done because the reduction in the growth of the money supply simultaneously causes both a slowdown in real growth and a higher real interest rate. The saving rate tends to be higher in years of slow growth, and savings will also tend to increase with higher real interest rates. The model only partially captures these effects, again because the level of variables such as real interest rates in the recent past and in the scenarios are far beyond the historical norm.

3. The interest rate-sensitive sectors

Automobile manufacturing and housing starts were adjusted in three of these scenarios. The cyclical response of activity in these sectors to interest rates may be understated in the model because of the stress placed on demographics.

4. The rate of change in the real wage

The rate of unemployment dampens wage demands and the growth rate of the real wage in the model, but the recent experience with protracted high levels of unemployment suggests that the growth of the real wage may depend heavily on how long the unemployment has persisted, in addition to simply the level of unemployment. In the scenarios which generated high levels of unemployment, the rate of growth in the real wage was adjusted downward roughly in proportion to the level and duration of unemployment.

ADJUSTMENTS

The magnitude of the first year adjustments to interest rates is based on the experience in recent years of the sensitivity of interest rates to the ratio of the money supply and nominal GNP. The add-factor in the first year of the scenario was proportional to the degree to which the growth rate of the money supply was reduced. The second year add-factor was affected by this consideration, but it was also necessary to start shortening the lag structure of the price expectations formation referred to above. In subsequent years the lags for price expectations were eliminated, with the current year's price being the only consideration.

The add-factors for the long-term rate were calculated to reflect the change in the price expectations procedure as well. This insured that the real long-term interest rate did not reach unreasonable levels. Note that the add-factors for the long rate must partially counteract the adjustments to the short-term rate. This is because the long-rate is primarily based on the short rate.

The judgmental increase in the savings rate for three of the scenarios was based on the fall in the growth rate of GNP and the size of the increase in short-term interest rates. It was assumed that for every one percent fall in the growth rate of GNP, there would be a 5 percent increase in the savings rate, and for every one percent increase in the short-term interest rate there would be a 5 percent increase in the rate of savings. The add-factors were initially based on the anticipated changes in GNP and interest rates, and were subsequently adjusted to roughly conform to these rules.

The adjustments to the rate of growth of the real wage rate (WRDAT), a variable which normally takes values on the order of 1.003 to 1.025, were proportional to labor market slackness. For every 100 basis points of change in the rate of unemployment from the baseline, the rate of change in the real wage was reduced .004. In the first two years the full reduction was not imposed, under the rationale that the persistence of unemployment is a major factor in the reduction in the rate of increase in wages. Also, many agreements are set for three year periods. Note that the add-factors for WRDAT are cumulative.

Auto sales and housing starts were modified because of the increase in interest rates. Retail sales of autos in the baseline were 9.9 million units in 1983 and grew fairly steadily throughout the forecast period to 12.4 million units. The shock of the high interest rates results in negative add-factors of 200 to 800 thousand units in the initial years, with these adjustments proportional to the increase in interest rates.

In later years add-factors were used to ensure that production levels approached the level of the baseline. Housing start adjustments were used in a similar way. In the worst scenario, the add-factors reduced total starts from 1.4 million in 1983 to 1.1 million. The adjustments on housing starts were phased out to allow starts to respond to the underlying demographic variables.

MONETARY POLICY SCENARIOS - Adjustments

Scenario #1

	1983	1984	1985	1986	1987	1988	1989	1990	1991
Interest rate adjustments									
Short-term rate (FRMLCDS)	2.2	2.	-1.	-3.7	-5.3	-5.5	-5.7	-5.8	-5.8
Long-term rate (FRMCS)	1.	0.	-.3	-.9	-.9	-1.1	-1.2	-1.3	-1.4
Savings Rate Adjustment									
Savings Rate (YPDSAVR)	.8	1.5	1.5	1.1	1.	.9	.8	.8	.8
Real wage rate adjustment									
Real wage rate (WRDAT)	-.001	-.004	-.011	-.011	-.013	-.014	-.015	-.016	-.016
Interest sensitive consumer sectors									
Retail auto sales (SAWRRDAV)	-.2	-.6	-.3	-.2	-.2	-.2	-.2	-.2	-.2
Housing starts, single (HSPRS1)	-.1	-.1	-.05	-.05	0	0	0	0	0
" " ,multiple(HSPRSM)	-.035	-035	-.017	-.017	0	0	0	0	0
" " , mobile homes (HSPRMH)	-.025	-,025	-.012	-.012	0	0	0	0	0

MONETARY POLICY SCENARIOS - Adjustments

Scenario #2

	1983	1984	1985	1986	1987	1988	1989	1990	1991
Interest rate adjustments									
Short-term rate (FRMLCDS)	2.5	-1.8	-6.5	-12.	-16.5	-19.	-22.	-22.3	-24.
Long-term rate (FRMCS)	.8	-.2	-2.	-2.8	-2.8	-2.8	-2.7	-2.1	-1.0
Savings Rate Adjustment									
Savings Rate (YPDSAVR)	1.1	1.9	1.6	1.3	1.1	.9	.8	.8	.8
Real wage rate adjustment									
Real wage rate (WRDAT)	-.001	-.004	-.015	-.0145	-.020	-.0205	-.027	-.027	-.029
Interest sensitive consumer sectors									
Retail auto sales (SAWRRDAV)	-.4	-.8	-.5	-.3	-.2	-.2	-.2	-.2	-.2
Housing starts, single (HSPRS1)	-.2	-.2	-.1	-.1	0	0	0	0	0
" " ,multiple(HSPRSM)	-.07	-.07	-.035	-.035	0	0	0	0	0
" " , mobile homes (HSPRMH)	-.05	-.05	-.025	-.025	0	0	0	0	0

MONETARY POLICY SCENARIOS - Adjustments

Scenario #3

	1983	1984	1985	1986	1987	1988	1989	1990	1991
Interest rate adjustments									
Short-term rate (FRMLCDS)	2.	2.2	[illegible]	-1.	-10.5	-14.	-15.5	-16.	-17.
Long-term rate (FRMCS)	.7	.3	-1.5	-1.2	-2.5	-2.5	-1.8	-1.1	-.9
Savings Rate Adjustment									
Savings Rate (YPDSAVR)	.5	1.2	1.2	1.1	1.	.9	.8	.8	.8
Real wage rate adjustment									
Real wage rate (WRDAT)	-.001	-.004	-.014	-.014	-.015	-.0175	-.022	-.0245	-.026
Interest sensitive consumer sectors									
Retail auto sales (SAWRRDAV)	-.1	-.4	-.15	-.1	-.1	-.1	-.1	-.1	-.1
Housing starts, single (HSPRS1)	-.05	-.05	-.05	-.025	0	0	0	0	0
" " ,multiple(HSPRSM)	-.017	-.017	-.017	-.008	0	0	0	0	0
" " , mobile homes (HSPRMH)	-.012	-.012	-.012	-.006	0	0	0	0	0

MONETARY POLICY SCENARIOS - Adjustments

BEST DOCUMENT AVAILABLE

Scenario #4

	1983	1984	1985	1986	1987	1988	1989	1990	1991
Interest rate adjustments									
Short-term rate (FRMLCDS)	-1	0	1	2	3.5	8	8.5	10.5	9.
Long-term rate (FRMCS)	.5	.5	.5	.5	.5	.9	.9	.5	-.4
Savings Rate Adjustment									
Savings Rate (YPDSAVR)	0.	0	0	0.	0	0	0.	0	0.
Real wage rate adjustment									
Real wage rate (WRDAT)	.002	.0065	.011	.01	.015	.017	.0175	.020	.0215
Interest sensitive consumer sectors									
Retail auto sales (SAWRRDAV)	0	0	0	0	0	0	0	0	0
Housing starts, single (HSPRS1)	0	0	0	0	0	0	0	0	0
" " ,multiple(HSPRSM)	0	0	0	0	0	0	0	0	0
" " , mobile homes (HSPRMH)	0	0	0	0	0	0	0	0	0